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AN ILLUSTRATED MONTHLY

Editor
GILBERT H. GROSVENOR

Assistant Editor
JOHN OLIVER LA GORCE

Associate Editors

A. W. GREELY
Arctic Explorer, Major Gen'l U. S. Army

C HART MERRIAM
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O. H. TITTMANN
Superintendent of U. S. Coast and Geodetic Survey

ROBERT HOLLISTER CHAPMAN
U. S. Geological Survey

G. K. GILBERT
U. S. Geological Survey

ALEXANDER GRAHAM BELL
Inventor of the Telephone

DAVID T. DAY
U. S. Geological Survey

DAVID FAIRCHILD
In Charge of Agricultural Explorations, Dept. of Agriculture

HUGH M. SMITH
Deputy Commissioner, Bureau of Fisheries

N. H. DARTON
U. S. Geological Survey

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THE NATIONAL GEOGRAPHIC MAGAZINE

THE NATIONAL GEOGRAPHIC SOCIETY'S ALASKAN EXPEDITION OF 1909

BY RALPH S. TARR, OF CORNELL UNIVERSITY, AND LAWRENCE MARTIN, OF THE UNIVERSITY OF WISCONSIN
LEADERS OF THE EXPEDITION

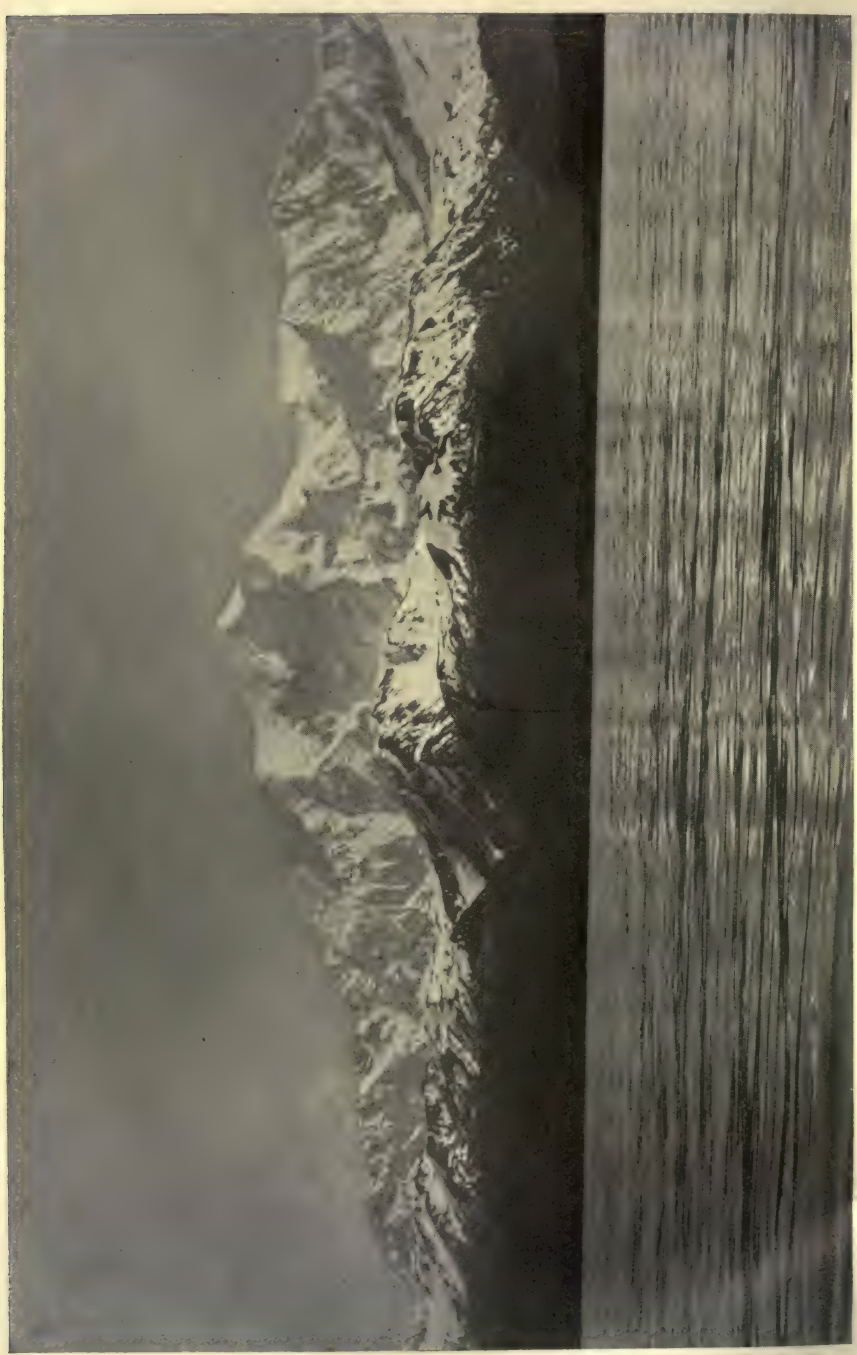
THE research expedition sent out by the National Geographic Society in 1909 devoted the season to a study of glaciers in Yakutat Bay and eastern Prince William Sound, Alaska. Beside the leaders of the expedition, the party consisted of six men. The topographer, Mr W. B. Lewis, of the U. S. Geological Survey, was furloughed by the Survey in order that he might be employed by the expedition. The other members of the party were a photographer, Mr Oscar von Engeln, of Cornell University; a geological assistant, Mr E. F. Bean, of the University of Wisconsin; a boat engineer, one camp hand, and a Japanese cook. The senior author had previously spent two seasons in Yakutat Bay, the junior author one season there and part of another in eastern Prince William Sound.

The party sailed from Seattle June 24, going via the Inside Passage and Juneau, and reaching Yakutat five days later. A 28-foot whale-boat with 4-horse-power gasoline engine was used in transporting the party and outfit throughout the summer, though taken on the steamship from Seattle to Yakutat and from Yakutat to Valdez. The first six weeks of the summer were spent in and about Yakutat Bay (June 29 to August 14), the remaining time in eastern Prince William Sound and around the lower Copper River. Two main camps and seven temporary camps were occupied in Yakutat Bay, and three main camps in eastern Prince William Sound. The glacier studies were accomplished by means of travel by water in launch and row-boat, travel by land and glacier on foot, and, in one case, travel by railway automobile over the Copper River and Northwestern Railway.

THE COUNTRY VISITED

The country studied is the mountainous region of the Pacific Coast slope of the Saint Elias and Chugach ranges. These mountains rise to heights of 8,000 to 10,000 feet, with peaks reaching 15,000 to 18,000 feet, and with snow fields covering the whole upland above 2,000 to 3,000 feet, except where the slopes are too steep. The upland is bare, cold, and cheerless; the lowland, quite in contrast, may be covered with spruce and hemlock forest or with luxuriant grass and flowers.

The region has a mild temperature,



MOUNT FAIRWEATHER (15,292 FEET HIGH), PHOTOGRAPHED FROM THE PACIFIC OCEAN BY THE NATIONAL GEOGRAPHIC SOCIETY'S EXPEDITION

THE PACIFIC COAST OF THE GULF OF ALASKA

Showing the location of Yakutat Bay, eastern Prince William Sound, and the lower Copper River region, where the National Geographic Society's Research Expedition spent the summer of 1909 in glacier study.

although in the latitude of Hudson Strait the lofty mountains, rising from the coast in the path of the prevailing westerly winds, cause heavy precipitation—81 to 190 inches annually—a large percentage of which falls on the mountains in the form of snow. Great excess of snow accumulation over melting has resulted in the formation of large valley glaciers, which descend from all the mountains, uniting to form the piedmont Malaspina and Bering glaciers and many intermediate piedmont bulbs.

THE LARGEST GLACIERS OUTSIDE THE POLAR REGIONS

The dimensions of the ice masses present is commensurate with the heavy snowfall and the northern latitude, many of the valley glaciers being of exceptional size. The Hubbard glacier* in Yakutat Bay, for example, has a total known length of 28 miles, only the lower portion being explored. It reaches the sea and discharges icebergs from a tidal cliff nearly five miles long and 250 to 300 feet high. Upon its lower surface three of the largest and best known Swiss glaciers—the Aletsch, Rhone, and Mer de Glace—might be superposed without covering the whole width of the glacier, as shown in the figure (see page 5).

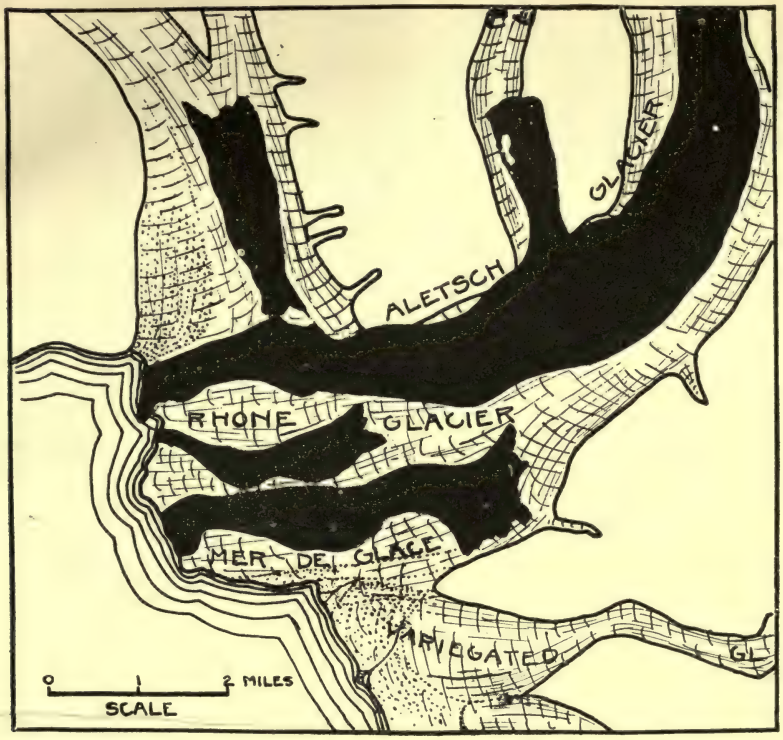
The front of this glacier is so high that a man's figure looks puny against it, and, indeed, a lofty modern office building, such as the Masonic Temple, in Chicago, might stand beside it and the roof would barely overtop the ice cliff, which also extends deep beneath the waters of the fiord. The *Times* building, in New York city, approximately equal in height to the Hubbard or Turner glacier front, is dwarfed by the giant mountains whose 8,000-foot peaks tower in the background.

The whole city of Washington, laid out upon the surface of Columbia glacier, gives a specific conception of the magnitude of these ice masses. One who has walked from the Capitol to the White House, or from the Navy Yard to the

*Named after Gardiner Greene Hubbard, first President of the National Geographic Society, by Prof. Israel C. Russell, who discovered the glacier in 1890 while leading the National Geographic Society Expedition to Alaska of that year.

MAP OF MALASPINA GLACIER, MOUNT SAINT ELIAS, AND YAKUTAT BAY

By Lawrence F. Martin, Department of Geology, University of Wisconsin. This glacier was discovered in 1791 by Alejandro Malaspina, a native of Italy in the service of Spain



THE LOWER PORTION OF THE HUBBARD GLACIER, WITH THREE GLACIERS OF THE SWISS ALPS SUPERIMPOSED UPON IT

All four glaciers are drawn upon the same scale, those from Switzerland being shown from the snowfields to the end of the ice tongue. The contrast of width and length of these glaciers in Switzerland and in Alaska is notable.

Zoological Park, can appreciate this distance across Columbia glacier (see p. 10).

The Malaspina glacier, however, fed by Agassiz, Seward, Marvine, and other valley glaciers which rival or exceed the Hubbard and Columbia in size, is so large that the whole State of Rhode Island could be laid out upon its 1,500 square miles of surface, or all of eastern Massachusetts. On the accompanying map it may be seen that if Boston were located in the eastern part of the Malaspina glacier the cities of Worcester and Gardner, in central Massachusetts, would be near the west edge (see page 9).

It was with ice masses varying in magnitude from that of Malaspina, Hubbard, and Columbia glaciers to the almost innumerable minor ice tongues that the investigations of the National Geographic Society's Alaskan expedition of 1909 dealt.

INCIDENTS OF A DAY

The day's work in Alaskan glacier study naturally introduces a variety of incidents, with the whole party sometimes united and sometimes divided; one group engaged in observation of the ice tongues, another in making topographic maps, a third in sounding in the fiord, etc. The day may start as early as half past four, and, in one case, began an hour earlier, because the Japanese cook made a mistake. Breakfast is eaten, apparatus and lunches are packed, and the start is made. It is light for twenty to twenty-four hours, so the start and return can be made at convenience.

TURNER GLACIER CLIFF COMPARED IN HEIGHT WITH THE NEW YORK TIMES BUILDING

Mountains in background, 10,000 to 11,000 feet

THE HUBBARD GLACIER CLIFF COMPARED IN HEIGHT WITH THE MASONIC TEMPLE IN CHICAGO

The innumerable branches of a glacial torrent often interpose obstacles to direct travel; the crevasses of a glacier surface make frequent detours necessary. While we were stopping for lunch at a glacier margin one day a series of avalanches built up a deposit of mud and stones 50 feet by 100 and from 5 to 30 feet thick. It contained boulders as much as 6 feet by 4 by 4 and shifted a stream 50 feet laterally into an alder thicket.

A brown bear with a half-grown cub, meeting one on the march and coming up to within 20 feet, lead one to sometimes wish for a gun, and, subsequently, to regret lack of presence of mind in utilizing the camera. The submerging at midnight of a camp on the beach by an exceptionally high tide, so that the water stands 14 inches deep on the tent floor, is not the pleasantest of incidents.

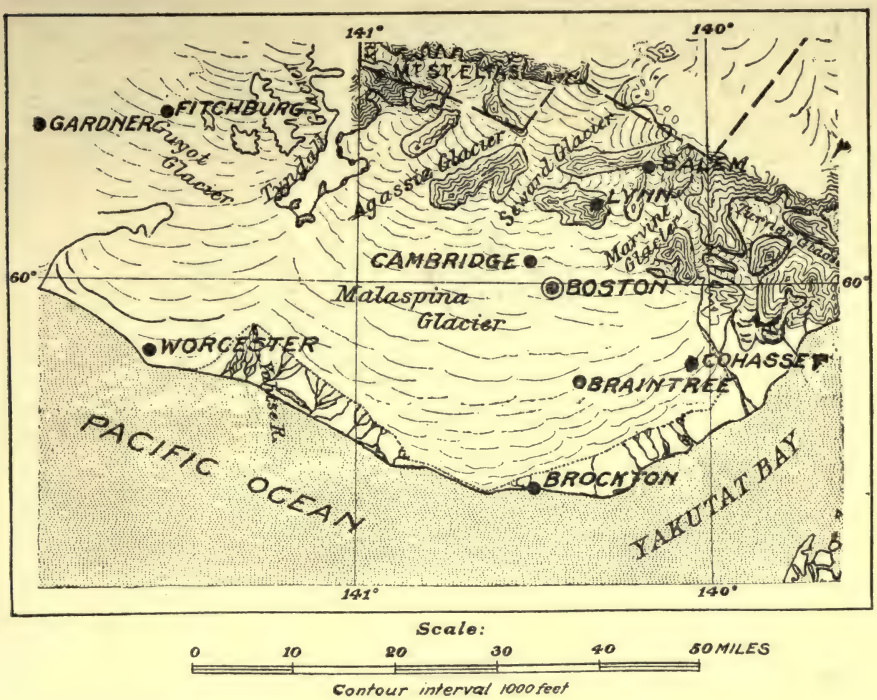
These accidents, however, are easily forgotten exceptions to the general rule of glacier study in Alaska. The series of beautiful panoramas of mountain and plain, fiord and glacier, the excellence and variety of glacial phenomena exhibited—all these lend zest to the work and make the season among the Alaskan glaciers far too short.

THE ENTERPRISE OF VALDEZ

In the regions visited by the National Geographic Society's Expedition the relations of the glaciers to life are striking. When stagnant and moraine-veneered the glaciers are the seat of abundant vegetation, which is destroyed when the ice tongues advance and when they melt and the moraine soil slumps down. As glaciers retreat, vegetation follows. The gravelly stream bottoms are the seat of vegetation which is easily destroyed by the rapidly shifting glacial streams.

The Malaspina and adjacent glaciers are used as highways of travel, the former being utilized by the mountain climbers, Russell, Bryant, and Abruzzi. The Nunatak and Fourth glaciers were crossed by hundreds of prospectors during the gold rushes, the latter being still a highway to the Alsek Valley. Glaciers and glacial streams also erode, transport, and deposit the gold which later concentration has made it profitable to wash on some of the Yakutat Bay beaches.

NUNATAK GLACIER AND ITS ICEBERGS (SEE ALSO PAGES 40 AND 44)



THE MALASPINA GLACIER, THE LARGEST IN THE WORLD OUTSIDE THE POLAR REGIONS

It is larger than Rhode Island or the eastern half of Massachusetts. The distances are shown by the location of the cities of Boston, Worcester, Gardner, Brockton, Cohasset, etc.

In eastern Prince William Sound Valdez glacier is the most famous of the glacier highways, and was traversed in the years of the gold rushes by four or five thousand prospectors.

The city of Valdez was located here because this ice-filled pass was possible to cross, and the exact location is determined by the head of ocean navigation on the fiord and a convenient plain built by glacial streams. Not long ago the city was threatened by floods from these same glacial streams. The glacier highway is no longer utilized, but the townsite is an equally convenient terminus to the government telegraph line, trail, and wagon road, several proposed railways, and the winter mail route to the Fairbanks gold camps on the Tanana River.

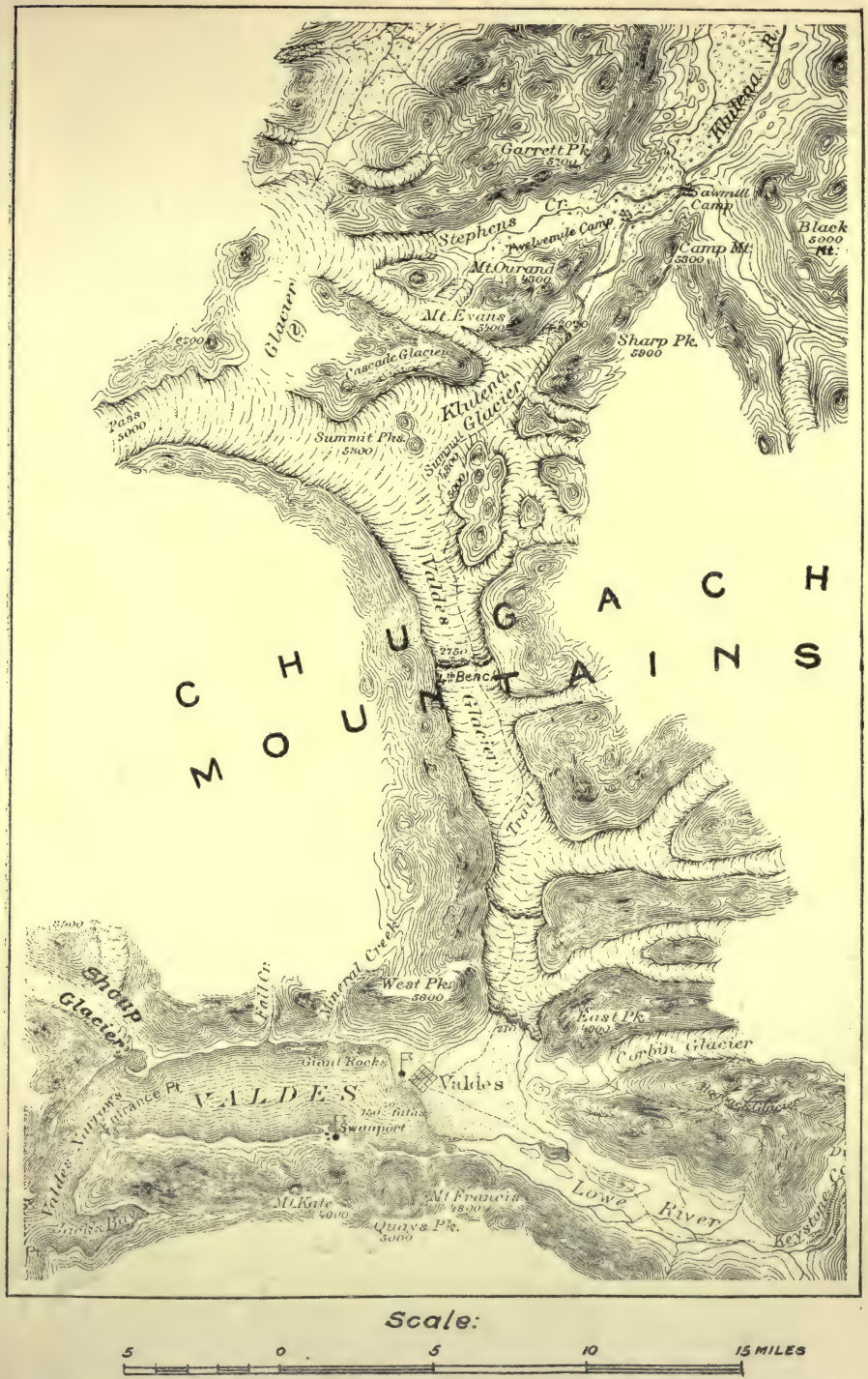
The enterprise of Valdez citizens has provided an automobile service between the town and the glacier, and on days of steamer visits the automobile makes many trips over the four-mile roadway that connects the glacier and dock. This is probably the only place in the world where automobile service over a glacial outwash plain takes the traveler to the very edge of an ice tongue.

The Shoup glacier, near by on Valdez fiord, is utilized by the United States Army as an ice-house, the soldiers from Fort Liscum, across the bay from Valdez, filling a lighter periodically with small icebergs from this glacier and towing them ten miles to the fort.

FORESTS DESTROYED BY ADVANCING GLACIERS

Around the Columbia glacier, as near the Lucia glacier of Yakutat Bay, the advance of the glacier into mature for-

THE COLUMBIA GLACIER, PRINCE WILLIAM SOUND, WITH THE CITY OF WASHINGTON DRAWN TO THE SAME SCALE FOR PURPOSES OF COMPARISON (SEE PAGES 30-33)



THE VALDEZ GLACIER HIGHWAY (AFTER SCHRADER, MAHLO, AND LOWE)

An ice-filled pass across the Chugach Mountains, crossed by thousands of prospectors. The Shoup glacier, used as an ice-house by the soldiers at Fort Liscum, near Swanport (see page 9).

THE CASCADING GLACIER AND MOUNT DRAPER

That the ice is able to remain on so steep a slope is due to a series of rock terraces, descending westward, which were sculptured by glacial erosion during a higher stage of Nunatak glacier. These terraces form steps upon which the ice rests, giving the appearance of an ice cascade.

ests during the summer of 1909 was resulting in the large-scale destruction of life. Ten years before, Dr G. K. Gilbert and the Harriman Expedition had found that the Columbia glacier was retreating from an advance into the forest, dated tentatively as in 1892. Professor U. S. Grant found that the Columbia glacier retreated 160 feet between 1899 and 1905, and readvanced 112 feet between 1905 and 1908. In the spring of 1909 he observed the continuation of this advance, seen also by the National Geographic Society Expedition in August. Mature trees had grown up to the very edge of Columbia glacier, and a readvance, overturning trees, thrusting splinters of ice up among their very branches, and rolling the peaty soil into great bolsters and terminal moraine ridges, include some of the profoundest effects of glacial conditions upon life (see pp. 32 and 37).

Where the great Copper River breaks through the lofty Chugach Mountains are displayed some of the most striking relationships between glaciers and human life. This water route to interior Alaska has always been blocked by lateral glaciers entering the Copper River Valley and causing ice barriers and rapids in the stream course. Few of the Russians succeeded in getting up the Copper, and difficulties here led to the utilization of the glacier highway at Valdez by most of the prospectors.

The army officer, Abercrombie, ascended to the Miles and Childs glaciers in 1884, and his photographs showing the glaciers and river there are almost identical with present conditions. Lieutenant Allen, in his brilliant explorations of 1885, passed these glaciers, as did Dr C. W. Hayes and Lieutenant Schwatka in 1891.* Hayes made the first detailed map of Miles, Childs, and Baird glaciers.

The map reproduced herewith, modified with a map made in 1900 by Schrader, Gerdine, and Witherspoon, shows the conditions. Miles and Baird glaciers, emerging on opposite sides of the valley, expand in piedmont bulbs. The Copper River writhes between them, forced first against one mountain wall, then the other. Above the glacier dams are lake-like stretches of the river. Childs glacier thus dams the Copper, causing a lake into which Miles glacier discharges icebergs from a cliff three miles long. There are similar slack waters above Miles and Baird glaciers. Opposite the glacier ends the river is constricted into foaming rapids (p. 25).

* National Geographic Magazine, vol. iv, 1892, p. 126.

THE GREATEST SCENIC RAILWAY IN THE WORLD

Under these difficult conditions a railway is being built. Its difficulties include three great bridges across the shifting glacial torrent of Copper River. They include expensive rock cuts, curves, etc., at Abercrombie Rapids, where Miles glacier and the river occupy the whole valley, forcing the railway to the mountain side. They include the laying of five miles of track *on the ice* of Baird glacier, whose advance would destroy the line and whose melting will keep it continually under repairs (see pages 23–25).

The project is daring, unique, but possible. Careful study has determined the necessities. Large capital has enabled wise work. Able engineers, including Messrs E. C. Hawkins, M. J. Heney, and Alfred Williams, who built the White Pass and Yukon Railway, are coping with the problems one by one. Men have never before built railways close to, between, and on great glaciers. But that it can be done is being proved in Alaska. The rich copper deposits north of the Chugach Range, near Mount Wrangell, and perhaps the valuable coal fields of the Controller Bay region, will soon be connected by rail with the growing port of Cordova, on eastern Prince William Sound.

Moreover, this will be the greatest scenic route in the world. Nowhere else can one step from an ocean steamship to a railway car, and ride through foothills, then over a great glacial delta to and between giant ice tongues two and eleven miles respectively in width, around the stagnant, moraine-veneered bulb of the

northern part of Miles glacier, past the beautiful Abercrombie Rapids, and over five miles of the stagnant Baird glacier. Here ice underlies the ties and rails, and a moraine with alders and cottonwoods covers the icy slope on one side, while the other is washed by the Copper River. All this we saw from a railway automobile or on foot, but readers of the NATIONAL GEOGRAPHIC MAGAZINE may see it next year from a train.

MANY GLACIERS SUDDENLY BEGIN A RAPID ADVANCE

In 1890 and 1891, when Professor Russell visited Yakutat Bay, during his explorations of the Mount Saint Elias region, under the auspices of the National Geographic Society and the United States Geological Survey, and in 1899, when Messrs Gilbert, Gannett, and other members of the Harriman Alaska Expedition entered the bay, the glaciers were found to be in a state of general recession. The authors of this article, in 1905, found clear evidence of continued recession of the glaciers of Yakutat Bay, the one notable exception being Galiano glacier.

In 1890 this glacier was covered by a dense growth of alder and cottonwood on its lower, stagnant, moraine-covered end, but in 1905, to our amazement, this forest cover was entirely destroyed. This remarkable change in condition of Galiano glacier puzzled us greatly, and the only hypothesis which we were able to suggest was that the series of vigorous earthquakes that visited the Yakutat Bay region in September, 1899, had in some way caused such an advance in the Galiano glacier as to completely destroy the vegetation which had previously clothed its lower end. The explanation was proposed as only a vague hypothesis forced upon us by the failure of other possible explanations; and we were not only ignorant of the nature of the process and its behavior, but wholly unprepared for the results which the hypothesis necessitated in other neighboring glaciers; for an advancing glacier under earthquake impulse was hitherto an unknown phenomenon of nature.

It was therefore a great surprise to the senior author when he returned to the Yakutat Bay field in the following summer (1906) to find that, although some glaciers had remained unchanged and others had continued their recession, so long in progress, four glaciers had undergone an abrupt and absolute transformation, similar to that of the Galiano glacier prior to 1905. One of these, the Variegated glacier, an alpine glacier of moderate size, which expands in a piedmont bulb beyond the mountain base, was carefully studied in 1905. Its lower end was essentially stagnant and covered with a sheet of ablation moraine arranged in bands of various colors, whence the name of the glacier. Over this moraine we could travel at will in any direction, and up the valley glacier within the mountain walls we made an excursion, in August, finding no other difficulty in traveling over the ice surface than that of an occasional crevasse which broke the otherwise smooth surface, and here and there a mound or ridge of moraine which rose above the clear ice that constituted the larger portion of the glacier within the mountain walls.

Nine months later all this was changed. The smooth, clear ice of the valley portion of the glacier was transformed to a sea of crevasses and seracs, like the broken ice of the ice falls in alpine glaciers; and the crevassing extended out into the moraine-covered piedmont bulb beyond the mountain base. Here not only was the ice so broken that it was impossible to travel on it, but it had thickened perceptibly and advanced noticeably. So great and absolute was the change in so short a time that it seemed almost incredible, and was wholly without precedent.

THE HAENKE GLACIER ADVANCES A MILE IN ONE YEAR

To the west of Variegated glacier lies the great Hubbard glacier, and still farther on the Turner glacier, also large, but

A MEADOW NEAR THE SEA, WHERE THE LUXURIANT VEGETATION CONTRASTS WITH THE BARE, COLD UPLANDS OF THE SAINT ELIAS RANGE

PANORAMA OF HUBBARD GLACIER: HUBBARD MOUNTAIN (12,964 FEET) IN BACKGROUND IN CENTER
This glacier and mountain were named for Gardiner Greene Hubbard, first President of the National Geographic Society. The mountain on the right is Mount Seattle

much smaller than the Hubbard. These two glaciers, ending in the bay in lofty ice cliffs, from which icebergs are constantly being discharged, had not suffered any notable change, but between them are two glaciers, to which no name had as yet been given, one of which, now called the Haenke glacier, had been subjected to changes similar to that of the Variegated glacier, while the other was unchanged. From a nearly stagnant, moraine-covered condition the Haenke glacier had become crevassed to an impassable condition, and its end had moved forward for about a mile. In September, 1905, its visible terminus was on an alluvial fan a quarter of a mile or more from the sea, but in June, 1906, the front was in the sea discharging icebergs and its sea cliff was united with that of Turner glacier.

Still proceeding westward, beyond Turner glacier came the Black glacier, which was unaltered; Galiano glacier, already mentioned, and then Atrevida glacier. In 1905 we were able to ascend the moraine-covered margin of the Atrevida with ease, and we wandered over its ablation moraine at will, while as late as September, 1905, the junior author made a trip completely across the glacier, as Russell had done on his way to Mount Saint Elias in 1890.*

*National Geographic Magazine, vol. iii, 1891, p. 92.

REMARKABLE CHANGES IN THE ALTREVIDA GLACIER

In June, 1906, the Atrevida glacier was marvelously transformed. Its margin was no longer moderately sloping and moraine-covered, but in its place rose a jagged ice cliff, advancing into the forest, and pouring into it a stream of boulders and other morainic debris that was constantly sliding down the newly formed ice cliff. The ice was in motion before our very eyes, and the cracking of the glacier, the tumbling of boulders, and the dislodging of huge ice blocks was heard on every hand. Viewed from a neighboring mountain top it was seen that the entire surface of the Atrevida glacier, from its valley head far out into its expanded, alder-covered piedmont bulb, was a mass of yawning crevasses. Travel over this tumultuous sea of broken ice was utterly impossible, and even the ascent of the margin was possible only by cutting ice steps all the way (see p. 39).

In a period of nine months a stagnant, or nearly stagnant, moraine-covered glacier had advanced, thickened, and become broken into an impassable condition, but neighboring glaciers showed no change from their condition of the previous year. For instance, the Lucia glacier, whose piedmont bulb joins that of the Atrevida on the west, and the Hayden glacier, further west, were unchanged.

West of the Hayden glacier the next large glacier is the Marvine, which descends from the mountains to form the eastern lobe of the great piedmont Malaspina glacier. This had been transformed as the Variegated, Haenke, and Atrevida had been. Where Russell easily crossed it in 1890, near its emergence from the mountain valley, the Marvine was now an impassable sea of seracs, and the eastern portion of the Malaspina, as far as Point Manby, at the western entrance to Yakutat Bay, was so broken that travel over its surface was no longer possible; yet it was over this portion of the Malaspina glacier that Russell traveled in 1890 and the Duke of the Abruzzi and Mr Bryant in 1897. The junior author saw the Malaspina and terminus of the Marvine in September, 1905, when it seemed exactly as in 1890. In 1906 the whole eastern margin of the Malaspina was observed by the senior author as a broken, jagged ice cliff, which was advancing in August, 1906, and destroying the forest that grew in the ablation moraine that had accumulated on this stagnant portion of the glacier.

EXPLANATION OF THE ADVANCE

In seeking an explanation for these phenomena there was no assistance to be gained from previous records of glacial changes, for such abrupt transformation of glaciers had never before been witnessed. Some unusual cause must have been in operation to have transformed stagnant ice into the broken, crevassed condition of rapidly moving glaciers, and to have caused a sudden forward movement and thickening of the lower portions of the glacier. Such an unusual cause at once suggested itself, for in September, 1899, the Yakutat Bay region was the center of a series of earthquake disturbances of great severity, and to the study of the effects of these earthquakes we had in 1905 given much attention, finding clear evidence of an uplift of the coast line (in one place to an elevation of 47 feet), of depression, of several fault lines, and of numerous avalanches.

As a result of a consideration of the phenomena observed in 1906 and of their possible explanation the senior author put forward the following theory as the only one that could adequately account for the facts, and against which there were no fatal objections:

In September, 1899, the severe shaking of the mountains during the earthquakes caused extensive avalanches of snow, ice, and rock from the lofty mountains into the reservoir of the glaciers of the Yakutat Bay region. This added so much to their supply that in time a response must necessarily be felt in the glaciers themselves. In the short Galiano glacier, and perhaps in others where not observed, the response occurred before 1905, and in 1906 the four glaciers mentioned were

SHOUP GLACIER, PRINCE WILLIAM SOUND

A glacier front of only moderate height, but one beside which the man's figure (left of lower center) looks puny. The American soldiers stationed at Fort Liscum obtain their ice supply from this glacier cliff (see page 9).

exhibiting the full effects of the response in the sudden addition to their snow supply. As the abrupt melting of snow in the headwaters of a river causes a flood which, in time, sweeps to the very river mouth, so in these glaciers the great and unusual addition of snow and ice during the earthquakes has given rise to an ice-flood which has swept down to the glacier ends. On this theory, therefore, the phenomena observed are explained as the result of a glacier flood started by earthquake impulse.

The observations of 1905 and 1906 were sufficiently extensive to at least lend strong probability to this theory, and it has been quite generally accepted. It was, however, of great importance to apply further test to the theory and to study the later phases of the phenomena attending such glacier advance; and therefore it was with keen interest that the authors again turned their attention to the Yakutat Bay region in 1909 under the auspices of the National Geographic Society.

If the earthquake theory were the correct explanation of the remarkable changes observed in 1906, three things were to be expected: In the first place, other glaciers should by that time begin to show the effects of the glacier flood; secondly, those glaciers which had already been under the influence of the glacier flood should begin to show signs of its diminution, though just what these signs would be or how rapidly the glacier flood would subside could not be predicted; thirdly, no such profound, spasmodic changes in the glaciers should be found in regions on either side of Yakutat Bay outside the area of severe earthquake shaking.

A study of these three points was the foremost object of the expedition of 1909, and the results of this study were in all cases in support of the theory previously proposed. If further demonstration of the accuracy of this theory were demanded than that previously presented, the results of the expedition of 1909 supply enough to establish the theory on a firm foundation. This additional evidence will be considered under the three phases mentioned above, beginning with a consideration of the new advance.

ADVANCE OF GLACIERS BETWEEN 1906 AND 1909

Several of the glaciers of Yakutat Bay have as yet suffered no change as a result of the earthquake shaking, so far as can be seen. This is true, for instance, of the Fourth glacier, which lies just east of the head of Yakutat Bay; of the tidal Nunatak glacier, that has continued the recession which has been in apparently uninterrupted progress since 1891, and whose ice cliff is now a mile and a half or more farther back than in 1899; of the tidal Turner glacier, which appears to be almost as it was in 1890, 1899, 1905, and 1906; of the Hayden glacier, the easternmost tributary to Malaspina glacier, which is in the same state as in 1905 and 1906; and of several smaller glaciers which are in the same state as in 1905 and 1906. But three large glaciers have come under the influence of the glacier flood since last seen in 1906.

Of these the largest and least effected is the tidal Hubbard glacier, which seemed, in 1909, to have just begun to come under the influence of the glacier flood. This is an active glacier, and since first observed by Russell, in 1890, has been crevassed from side to side and has poured a steady stream of icebergs into the fiord from its 5 miles of ice cliff. But beyond the mountains the extreme eastern margin, blanketed by a cover of lateral moraine, has been in a semi-stagnant state, and, where it projected into the sea, rose as a dirt-stained ice cliff from which the discharge of icebergs was infrequent. Back from this ice cliff, on the land, was a moraine-covered ice slope in which little ice showed, and up which it was easy to climb to the glacier surface (see pages 16 and 35).

HUBBARD GLACIER IS EVIDENTLY ON EVE OF GREAT MOVEMENT

In 1909, however, this moraine-covered land slope of the glacier margin was being destroyed; the ice was pushing out

BRAIDED STEAM COURSES WHICH EXPLORERS FIND DIFFICULT TO CROSS

TRAVEL TO THE GLACIERS BY BOAT AMONG THE ICEBERGS AND OVER THE GLACIER SURFACES ON FOOT

THE AUTOMOBILE IN FRONT OF VALDEZ GLACIER (SEE PAGE 9)

through the moraine, and bare, steep, ice cliffs were developed in place of the former morainic slopes. The ice cliff was broken, and blocks of ice, dislodged, were falling to its base, while the moraine, in the grasp of running water liberated from the newly exposed ice, was being deposited on the mud flat at the base of the glacier, burying willow bushes and annual plants that had previously been growing there. From the sea cliff many icebergs were being discharged, proving still further that this margin of the glacier had begun to advance; but we could not be certain that the main part of the glacier was also moving forward more rapidly than before, although it seemed to us that the cliff was higher and there was more ice in the fiord, and more frequent discharge of icebergs than in 1905 and 1906.

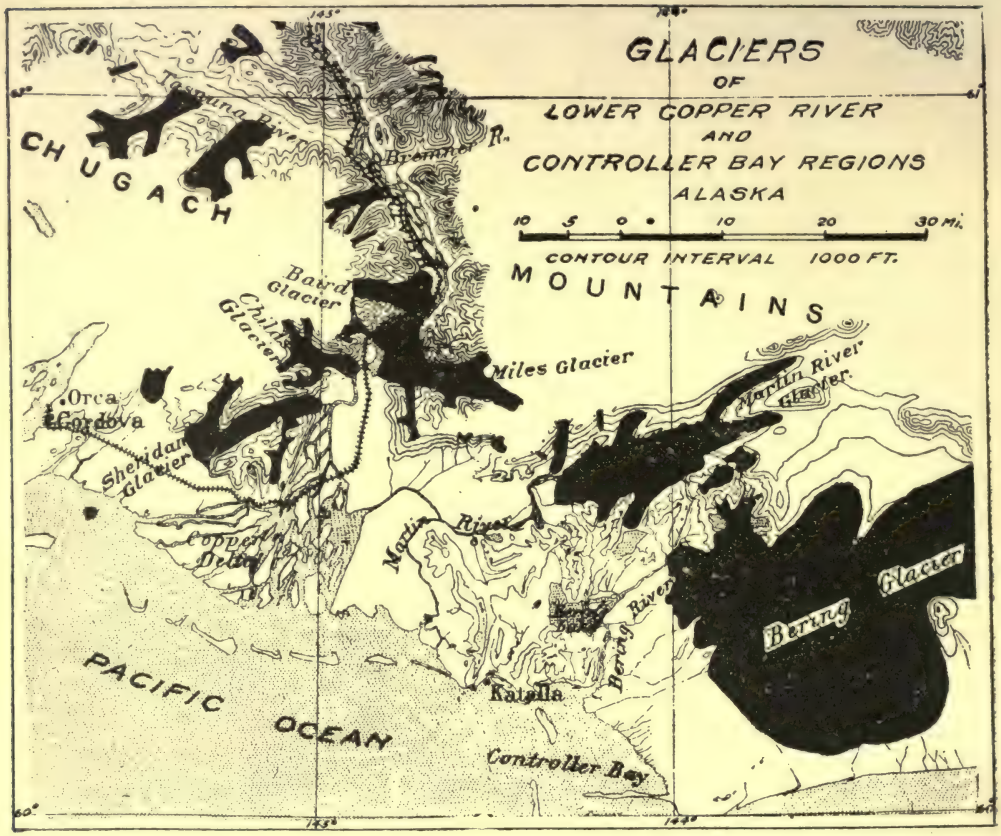
From the condition of Hubbard glacier we conclude that an advance under the flood impulse had just begun in the summer of 1909, certainly along the eastern margin, and perhaps throughout the entire glacier. It would, therefore, be of great interest to return to it in 1910 to see exactly what change follows, for in this case we seem to have discovered a glacier showing the very first signs of advance. It will also be interesting to observe whether all or only a part of the glacier feels the flood impulse, for Hubbard glacier is made by the union of two very large tributaries, and each of these has large feeders. By the flood explanation it is not to be expected that glaciers of different lengths, with different numbers of tributaries, and with different conditions in their reservoirs, will advance at the same time.

It is quite possible that the eastern side of Hubbard glacier will respond to the glacier flood at a different time and in a different amount than the western margin, which is supplied from an entirely different source. Indeed, even the same side may advance under the influence of the flood from some of its larger feeders, then halt, and later advance again under the flood impulse supplied from more re-

MILES GLACIER AND LAKE (SEE PAGE 13)

FERRY SLIP: STAGNANT PORTION OF MILES GLACIER ON LEFT

M. J. HENEY'S CONSTRUCTION CAMP 55, WITH TENT HOUSES



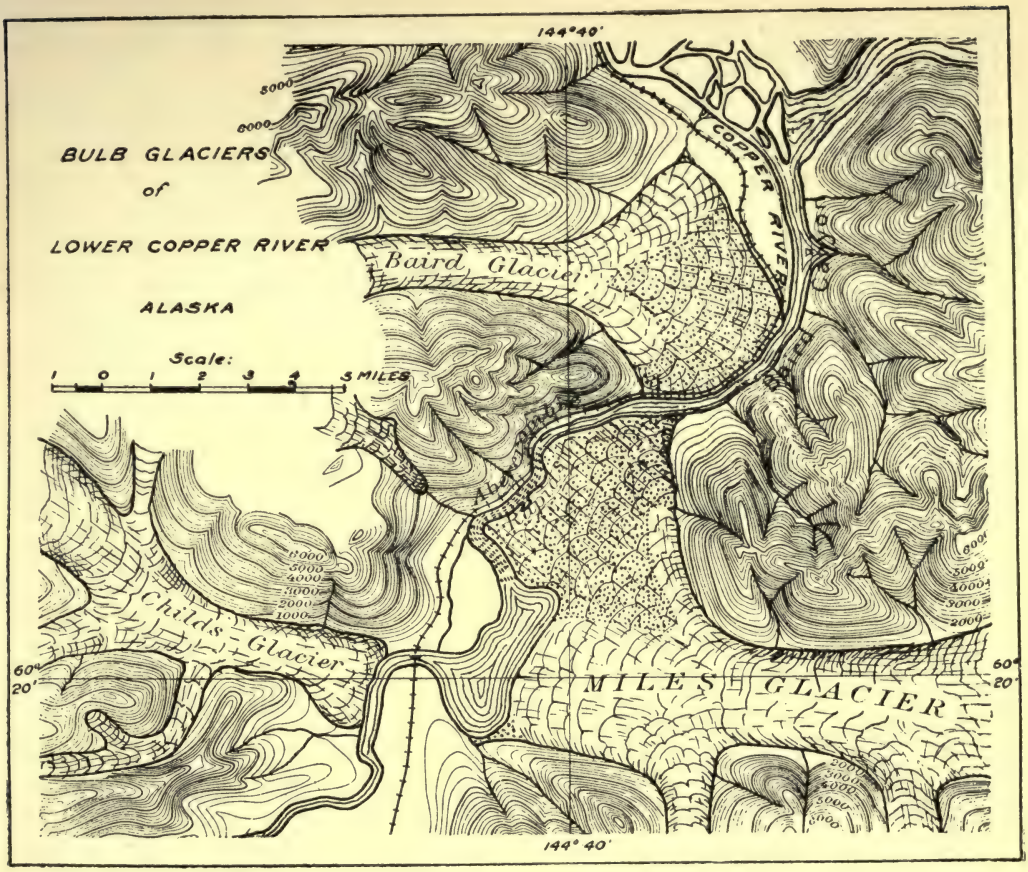
MAP OF PART OF ALASKAN COAST (AFTER U. S. GEOLOGICAL SURVEY)

Showing glaciers of lower Copper River. The water at the delta is so shallow that the terminus is at Cordova to the west. There are valuable coal fields between Bering and Martin River glaciers and rich copper deposits north of the Chugach Mountains (see pages 13 and 37).

mote reservoirs. The entire phenomenon of advancing glaciers as a result of earthquake shaking is so little known that it is difficult to accurately predict results, and consequently it is highly important to maintain observations so that this novel and interesting phenomenon may be more thoroughly understood.

LUCIA GLACIER HAD BECOME IMPASSABLE

The second glacier that has been brought under the flood impulse since last seen in 1906 is the Lucia glacier, which lies next west the Atrevida, and whose lower, stagnant end coalesces with the Atrevida glacier. The expedition of 1906 crossed the Lucia glacier from west to east in order to study the western margin of the Atrevida glacier, which had become so crevassed between 1905 and 1906 that it could no longer be crossed. The Lucia was then in the same condition as when crossed by the junior author in 1905 and by Professor Russell in 1890—that is, the Lucia glacier, fed by many tributaries, emerged from its mountain valley as a partly moraine-covered glacier, with so little crevassing that it could be easily traversed in any direction. Beyond the mountains it expanded into a piedmont bulb covered with moraine, and its outer margin was so stagnant that it was covered by a dense growth of alder and cottonwood. On the western side, near



THE COPPER RIVER AND NORTHWESTERN RAILWAY PASSING BETWEEN CHILDS AND MILES GLACIERS AND OVER THE STAGNANT ICE OF BAIRD GLACIER

Trains now cross the Miles Glacier Lake on a car ferry, pending completion of the bridge across Copper River. (Map after U. S. Geological Survey.) (See pages 13 and 37.)

Floral Pass, the glacier split against a rock hill, or semi-nunatak, sending a small tongue part way down the valley on the western side of the nunatak.

In 1909 the Lucia glacier was absolutely transformed. It was crevassed from side to side, so that the route to Floral Pass, so easily followed in 1890, 1905, and 1906, was no longer passable. The glacier was broken by great rents, enclosing table-topped areas of unbroken ice, on which the ablation moraine still stood, and along the margin, as well as within the mountain valley, was a maze of crevasses, seracs, and pinnacles, giving the ice surface the appearance of an ice fall, where but three years earlier one could walk in any direction with only an occasional crevasse to impede the journey. Along the eastern margin the breaking of the glacier was still in progress and the cracking of the ice and the falling of ice blocks was heard every few moments, while the moraine was all the time sliding down the ice face or into crevasses (p. 41).

Where in 1906 was a moderately sloping embankment of moraine-covered ice, up which we could easily climb at any point, there was in 1909 an ice precipice with jagged, serrated skyline, due to the recent breaking of the glacier. On the western margin, which we were unable to

visit, but saw from a distance, the ice had crowded up on the stoss side of the nunatak nearly to its top, while the distributary west of the nunatak had protruded entirely through its valley and was nearly, if not quite, united with the main glacier below the nunatak.

In the central part of the glacier the new-formed rents extended down into the previously nearly stagnant bulb, but not into the alder-covered zone. There the advance of the Lucia had not extended so far as that of the Atrevida in 1906, when the broken ice affected even a part of the alder zone of its piedmont bulb. But it seems probable that the advance of Lucia glacier, which was certainly in progress in the summer of 1909, was not as far advanced as that of the Atrevida in 1906. As will be seen from the descriptions which follow, the flood impulse is rapid and soon dies out. Quite probably the flood of the Lucia will have attained its height by 1910.

REMARKABLE TRANSFORMATION OF HIDDEN GLACIER

While the Hubbard glacier is apparently in a very early stage of advance, and Lucia glacier has not yet reached the maximum of its flood stage, the Hidden glacier has entered upon and completely passed through flood condition in the interval between 1906 and 1909. In late June, 1906, the Hidden glacier was seen and photographed from near the sea, but it was then so like its condition in 1905 that it was not studied further; but in 1905, because of certain interesting phenomena, it was studied carefully, and photographed from various points. It was then, and in 1906 still was, a low grade, smooth-surfaced glacier, almost, if not quite, stagnant, ending in a gently-sloping front, quite free from débris, over which one could easily travel in all directions. The ice front lay about 2 miles from the sea, and in the interval between Gilbert and Gannett's visit in 1899 and ours in 1905 it had receded about a quarter of a mile. Beyond the apparent front of the glacier, between it and the sea, lay a pitted gravel plain, partly resting on stagnant ice still connected with the glacier. Altogether the Hidden glacier was so perfect a type of an inactive valley glacier in a waning state that one would never have thought of predicting for it a sudden change to activity and complete transformation to a broken condition. Yet that is exactly what happened immediately after it was last seen in 1906, and possibly even late in that year (see pages 42–43).

Notwithstanding the almost magical transformation of glaciers to which we had by that time become accustomed, our astonishment was so great as almost to make us disbelieve our own senses when Hidden glacier burst upon our view in July, 1909. Russell called this Hidden glacier because, as he sailed up Russell Fiord, it was almost hidden from view, appearing for only a short time as its valley opened, revealing the glacier nestled between the steep mountain walls over 2 miles from the sea. As we rounded the northern wall of the valley in July, 1909, the glacier burst upon our view so high and so near that we at first thought it tidal. As a matter of fact, its front was still a quarter of a mile from the sea, but it was nearly 2 miles farther down its valley than in 1905 and 1906, and higher and steeper than the front then was. It had advanced over all of our bench-marks and important photographic sites which we had located primarily for the purpose of recording future recession. The most important of our sites was beneath 500 feet of ice and in front of it stretched 2 miles of glacier.

Not only had the glacier advanced, but it had become profoundly crevassed. However, the advance had occurred so long ago that ablation had healed much of the crevassing, making it possible for us to travel over parts of the glacier surface, though only when the party was roped together, and then by the use of much care, and with many detours around yawning crevasses. The glacier surface was far different from the smooth state of 1905 and 1906. It was a tumultuous series of great swells and troughs, with abundant crevasses, in spite of the pronounced

A SHARP CURVE IN THE RAILWAY AT ABERCROMBIE RAPIDS: A NARROW SHELF BLASTED OUT FOR THE ROAD

THE COPPER RIVER AND NORTHWESTERN RAILWAY UNDER CONSTRUCTION ON THE STAGNANT ICE OF BAIRD GLACIER (SEE PAGES 13-14)

Copper River on one side, ice beneath, glacial ice with moraine and forest on the other side

THE RAILWAY AUTOMOBILE AND MR WILLIAMS, ASSISTANT ENGINEER OF THE RAILWAY

Forest-covered Baird glacier in the background. The leaders of the National Geographic Society's Expedition traveled 125 miles in the car, through the courtesy of the Katalla Company, who are building the railway, and Messrs Hawkins and Williams.

ablation which had evidently been in progress since the glacier spasmodically rushed forward. So much ablation had taken place that we are certain that the advance occurred at least as early as 1907 and perhaps in 1906. The advance must have been rapid, occupying only a small period of time, for, at most, there were only three years for the advance, breaking, and partial healing by ablation, to a state permitting travel over the surface. It is a pity that there was no one at hand to witness the beginning and progress of this marvelous change in glacier condition, the most spectacular of all so far recorded in the Yakutat Bay region, or, for that matter, in all the world.

PRESENT CONDITION OF THE GLACIERS THAT ADVANCED IN 1906

Our second principal line of inquiry was with reference to the condition of the four glaciers whose remarkable advance was discovered in 1906. In the summer of that year the Variegated, Haenke, Atrevida, and Marvine glaciers were in a state of activity which contrasted strikingly with their inactive condition nine months before. The observations of 1906 were upon glaciers in full flood stage, and if, as proposed by the theory, this spasmodic transportation was the result of an impulse due to the accession of large quantities of snow and ice shaken down into the reservoir in a period of three weeks of earthquake shaking, it was to be expected that the full force of the advance would soon be spent.

It was, therefore, with great interest that we returned to an examination of the transformed glaciers. Our expectations were more than realized, for we were quite as unprepared for so sudden a cessation of activity as we had been for the spasmodic advance and breaking observed in 1906. From our study in 1909 it has become evident that the advance of the glaciers, begun between September, 1905, and June, 1906, ended before the summer of 1907. By this it is not meant to assert

that *all* forward motion ceased thus abruptly, though this also may have been true, but merely that the rapid movement which broke the surface of the glaciers into impassable condition came to an end at least as early as the beginning of the summer of 1907, and that the spasmodic advance, from beginning to end, was accomplished within a period of not over one year.

The evidence of this almost incredibly rapid change from stagnation to great activity, and then back again to stagnation, is clear and convincing, though in an article of this length it cannot be discussed with sufficient fullness to marshal all the proof. The proofs of the abrupt advance have already been stated in this paper, as well as much more fully in other publications relating to the studies of earlier years. That the advance so actively in progress in the summer of 1906 did not extend into the summer of 1907, is suggested by the extent to which ablation has healed the crevassing caused by the spasmodic advance. The ice surfaces upon which we could not travel at all in 1906 were again passable in 1909.

We walked across the lower end of the Variegated glacier, and crossed the Atrevida glacier to Terrace Point, and although we did not go to them, it was evident that both the Haenke glacier and the eastern, or Marvine, lobe of the Malaspina glacier could be traversed without great difficulty. For ablation to so heal the broken ice surface as to permit travel over it time is required, and it is inconceivable that the single season of 1907 was sufficient for this extensive ablation. In the period of time required must certainly be included the summer of 1907. Contributory evidence is supplied by Hidden glacier, whose entire advance and ablation to passable condition took place after June, 1906; but travel over this glacier is more difficult than over those glaciers which advanced early in 1906, for there has been less time available for the reduction of the roughened surface by ablation.

Other more definite proof that the advance ceased within a few months after our study of 1906 is furnished by each of the glaciers. The front of the advancing portion of Variegated glacier has gone no farther than where it stood when last seen in 1906; Haenke glacier front is not quite so far out now as then; the eastern margin of Atrevida glacier advanced a little further, but the extent of breaking out in the alder-covered stagnant bulb is the same as in 1906, even the same rings of broken ice in the alder thicket being present; and along the eastern margin of Malaspina glacier the forest growth on the ablation moraine of the stagnant ice was not entirely destroyed, although in the summer of 1906 it was disappearing at a rapid rate.

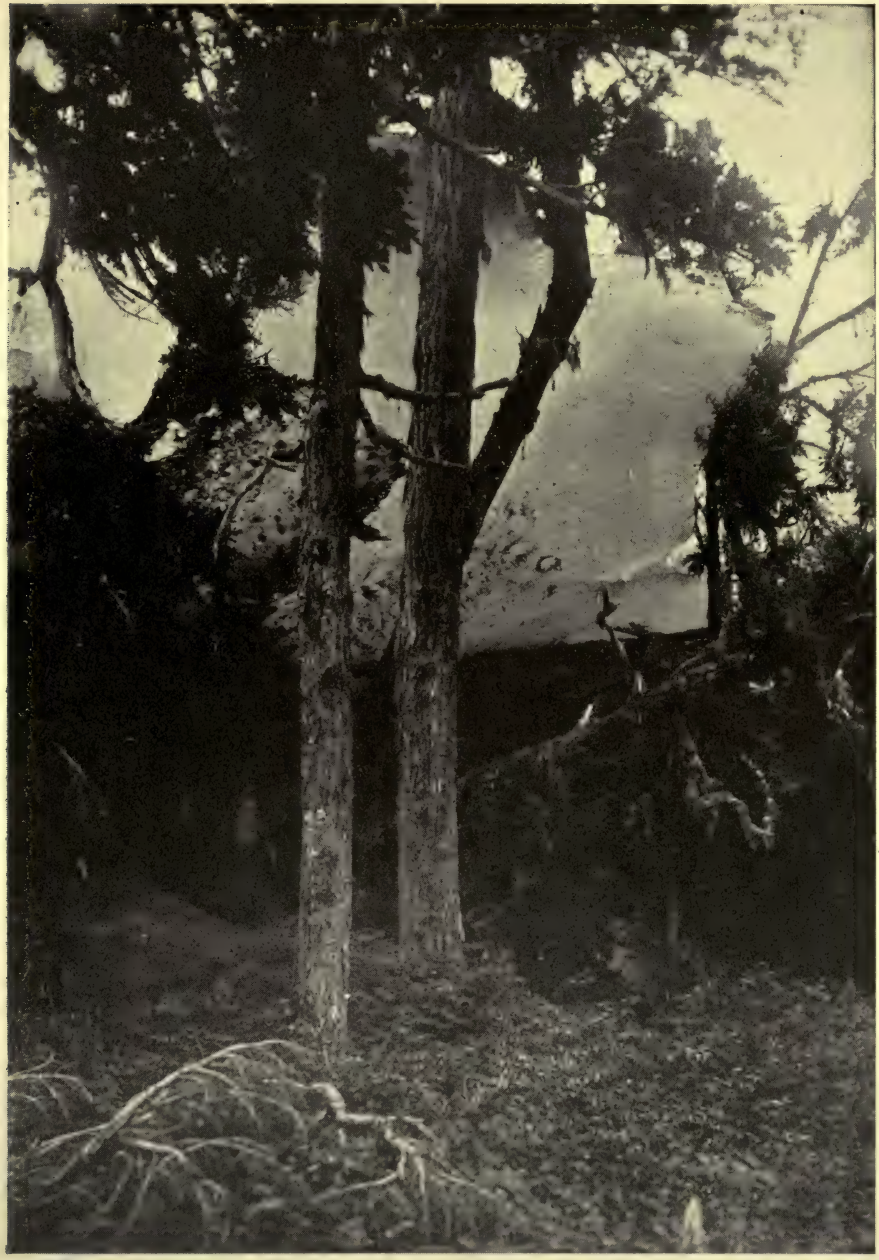
In a word, although the change in glacier condition between September, 1905, and June, 1906, was marvelous in these four glaciers, the changes between August, 1906, and July, 1909, have been of almost no consequence, excepting only such extensive ablation as to render the glaciers once more passable. It is not to be inferred, however, that ablation has so reduced the irregularities caused by the breaking of the glaciers in their flood stage as to bring about again the undulating, easily traversible surfaces of 1905. The condition of the glacier surfaces is far different from that of the period before the advance, and travel over them is as yet by no means easy. The surface rises and falls in a series of great waves and troughs, and crevasses are encountered at frequent intervals. Nevertheless, the ice surface of these glaciers more closely resembles the condition of 1905 than that of 1906. It is evident that they have once more relapsed into the stagnant or semi-stagnant state by which they have been characterized since first discovered and studied.

The observations of 1906 proved that the advance of the glaciers under the impulse of increased supply furnished by earthquake shaking was rapid, and the observations of 1909 prove that the impulse is spasmodic and of brief duration. The entire cycle, from gently undulating ice surface, through the broken stage of the glacier flood, and back to the normal

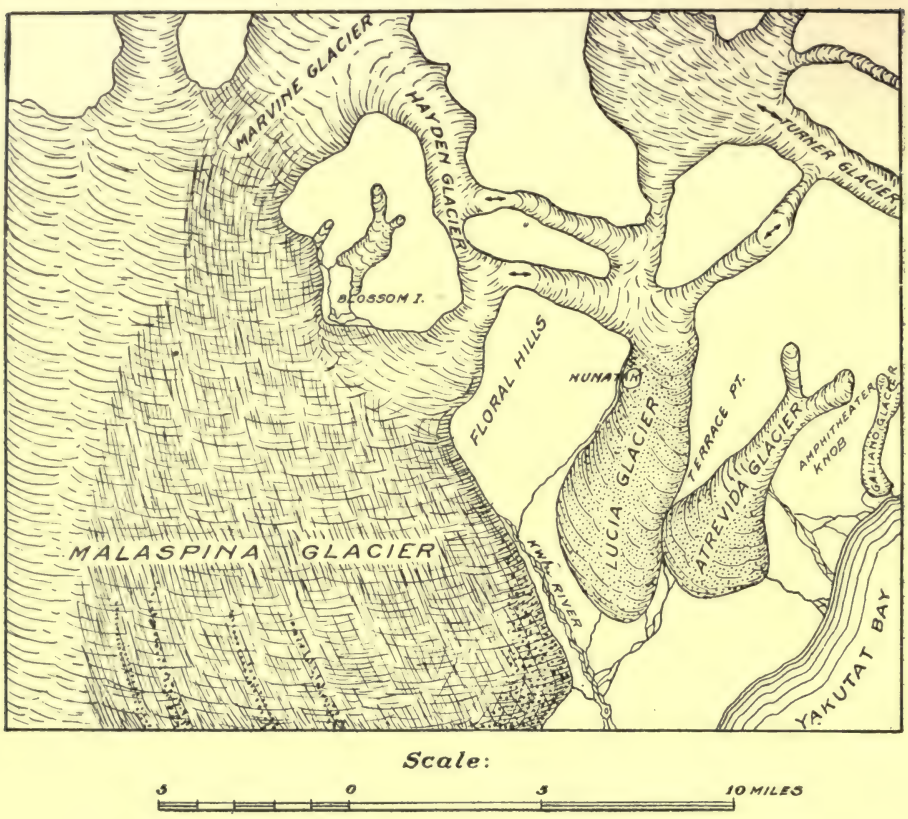
WEST MARGIN OF COLUMBIA GLACIER, AS PHOTOGRAPHED BY GILBERT IN 1899 AND BY THE NATIONAL GEOGRAPHIC SOCIETY'S EXPEDITION IN 1909, AFTER THE RECENT ADVANCE (SEE PAGE 37)

EAST SIDE OF COLUMBIA GLACIER, PHOTOGRAPHED IN 1909 FROM EXACT SITE UTILIZED BY GILBERT TEN YEARS BEFORE: ADVANCE SHOWN IN LOWER PHOTOGRAPH

COLUMBIA GLACIER ADVANCING INTO FOREST, OVERTURNING TREES AND SHOVING UP A MORAINE (SEE PAGES 9–13, AND 37)



ICE OF COLUMBIA GLACIER OVERTURNING MATURE FOREST



ATREVIDA, LUCIA, AND MARVINE LOBE OF MALASPINA GLACIER

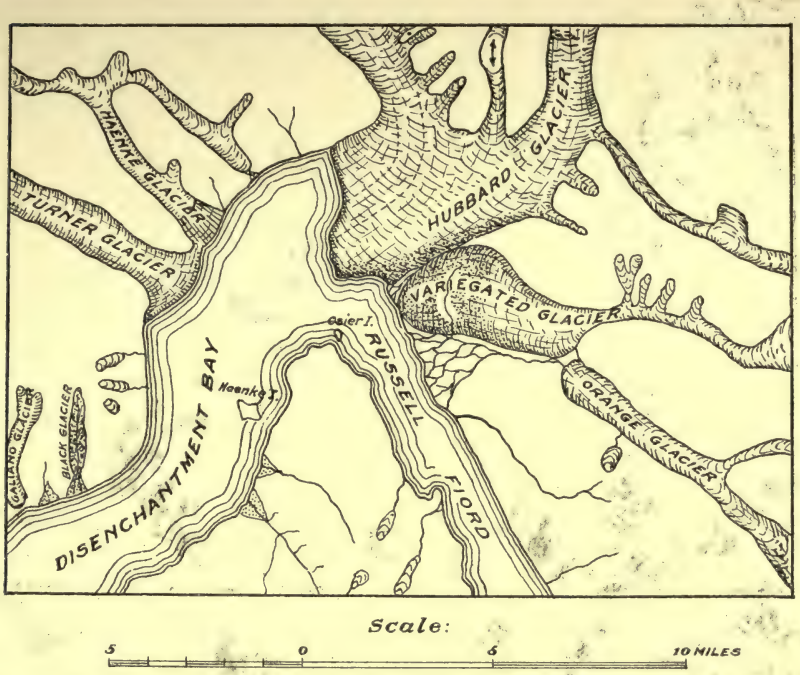
Atrevida and Malaspina glaciers advanced between 1905 and 1906, while Lucia glacier was advancing in 1909 (see pages 17, 24 and 25)

condition of the stagnant glacier, is compassed in a period of but a few years, say from four to six years. Surely the term glacier flood is warranted for such a sudden change in ice condition.

This is not the place for a discussion of the validity of the earthquake theory for these remarkable changes, but it may, nevertheless, be pointed out here that, while this theory accounts for all the facts, and stands all the tests applied to it, no other explanation that has so far been suggested can be considered even rational enough to be retained as an alternate hypothesis. We believe, therefore, that we are warranted in claiming that a new cause for glacier advance has been discovered, for the theory of advance under earthquake impulse, first put forward by the senior author as a result of his observations of 1906, has, by the additional evidence discovered in 1909, been put to such tests as to completely verify it.

GLACIERS OF OTHER SECTIONS SHOW NO EVIDENCE OF SPASMODIC ADVANCE DUE TO 1899 EARTHQUAKES

There is, however, one further test that we were able to apply as a result of the field work of the 1909 expedition. It has seemed to us reasonable to expect that, since the earthquakes of September, 1899, were centered in and about the Yakutat Bay region, the spasmodic advance of glaciers should be confined to that region, or, at least, should not be



VARIEGATED AND HAENKE GLACIERS

Which were stagnant and easy to cross in 1905, crevassed and impassable in 1906, and stagnant and passable in 1909. Hubbard glacier, perhaps, began an advance in 1909 (see pages 16, 17, 19 and 22).

noticed far to one side of the area of vigorous shaking. Just what is to be expected near the periphery of the area of maximum shaking we are not in a position to predict, though it is to be expected that there, also, some response, probably less spectacular, should occur. In a single field season we could not, of course, cover an extensive area in personal field work, but we were able to do some work in the Prince William Sound region and in the Copper River Valley, and we made some observations on glaciers visible from the steamer and made inquiries regarding them.

So far as we could learn from our inquiries none of the glaciers of the Inside Passage have undergone any notable transformation since 1899, excepting that of recession as exemplified especially in the Muir glacier. The Brady glacier, near which our ship anchored for the night, has not changed notably since 1905, when we last saw it, and we could not detect any changes in the great glaciers which descend the western face of the Fairweather Range, although it should be stated that most of these were seen from such a distance that we could have detected only extensive changes. These glaciers, together with the Brady, Muir, and others in this vicinty, are within the area shaken during the September, 1899, earthquakes and may be expected to respond, to some extent at least, to the effects of this shaking.

The natives residing at Dry Bay, 60 miles southeast of Yakutat Bay, report that in the summer of 1909 there were remarkable and long-continued changes in the volume of the Alsek River, which may be related to the advancing and breaking of some of the glaciers whose ends lie up this valley. We may expect advance in these glaciers, for their sources lie in the snow fields of mountains within the area of vigorous shaking during the 1899 earthquakes.

THE HUBBARD GLACIER IN 1909 FROM OSIER ISLAND

Our actual field work on areas outside of the Yakutat Bay region was entirely to the northwest. Here, in Prince William Sound, we found the large Valdez glacier continuing the recession which has been in progress, with one possible slight advance, since 1899. There has also been a retreat since 1898 of the Shoup glacier, which, however, is smaller than the Valdez. On the other hand, the still larger Columbia glacier, the greatest in this region, and comparable to the Hubbard, was again advancing into the forest in 1909, as it had seven years before 1899, when studied by Dr Gilbert. Prof. U. S. Grant has shown that there was a period of recession in the Columbia glacier between 1899 and 1905, followed by slight advance between 1905 and 1908. The present advance, which has gone beyond that of 1892, does not appear to be of the same order as that of those Yakutat Bay glaciers which are advancing under the impulse of earthquake shaking. It may be the beginning of a spasmodic movement, or it may be a slow forward swing such as comes from moderate variation in snow supply. Moreover, we would hardly expect the largest glacier to be the first to advance under the earthquake influence. However, it will be important to watch this glacier in the next few years (pp. 30–33).

In the Copper River Valley, although several other glaciers were seen, and showed no sign of recent notable advance, we gave special attention to the three largest, the Baird, the Miles, and the Childs. That the Baird glacier has long been stagnant is proved by its moraine-covered piedmont bulb, bearing a growth of mature alder (see pages 24–25).

The Miles glacier is more active and discharges icebergs into the Copper River from a long ice cliff; but its alder-bearing, moraine-covered piedmont bulb on the north side shows a long period free from advance, photographs and maps by Abercrombie in 1884, Allen in 1885, Hayes in 1891, and Schrader in 1900 verifying this inactivity.

The Childs glacier, which is also actively discharging icebergs into the Copper River directly opposite the Miles, has not recently been much farther out than now, but it is reported by the engineers of the Katalla Company, who are building the Copper River Railway, to be more active in 1909 than previously, and to have advanced somewhat.

In view of the great economic importance of these three glaciers, between two of which, and *on* one, the Copper River Railway is now built, it is of high importance that these three glaciers be carefully mapped and studied. The fate of the railway to the copper fields depends upon the behavior of these three glaciers, and since they are now so easily accessible and so interesting—the only case in the world where two large iceberg-discharging glaciers can be seen from a railway train which passes between them—they are likely to be much visited in the immediate future.

From our observations and inquiries of 1909 we are led to believe that the spasmodic advance of glaciers, so vividly illustrated by six of the glaciers in the small area of Yakutat Bay, has probably not been duplicated in the regions to the northwest and southeast. It is, of course, recognized that such negative evidence is not wholly conclusive, since our observations have not included all the glaciers or even a large proportion of them. But it is, nevertheless, considered as contributory evidence that in our search to the northwest and southeast of the Yakutat Bay region we have so far failed to find a duplication of the marvelous transformation of glaciers observed there. So far as it goes, this evidence tends to verify the theory of local cause for glacier advance in Yakutat Bay. Further study in the areas beyond the limit of vigorous shaking by the 1899 earthquakes should be expected to bear similar testimony.

There have been world-shaking earthquakes originating near the Prince William Sound and Copper River regions, of which those of October 9, 1900, and February 14, 1908, are good examples, though less severe than the three weeks of earthquakes at Yakutat Bay in Sep-

MORAINE-VENEERED EAST MARGIN OF HUBBARD GLACIER IN 1909

Showing dark-colored ice projecting through moraine, as if glacier were about to advance

tember, 1899. Avalanches accompanied these shocks also. These facts may complicate the situation somewhat.

OTHER RESULTS OF THE NATIONAL GEOGRAPHIC SOCIETY'S 1909 EXPEDITION

The problems connected with the remarkable changes in the Yakutat Bay glaciers, and with the explanation of these changes, have claimed first attention from the authors, for these seemed to be the most inviting and important phases of work on Alaskan glaciers at present open to the student. It scarcely requires statement, however, that other problems also received attention of students of glaciers and glaciation whose good fortune it was to be given the opportunity to study in a field so rich in glacial phenomena as that of the Alaskan coast. This is not the place for a full statement of the results of our summer's work; that must be deferred until the appearance of our final report. Still a summary of some of the more important phases of these other results may appropriately be introduced here.

The Alaskan Coast region is not only the seat of the largest glaciers on the continent, and in fact of some of the largest in the world, outside of the Arctic and Antarctic regions, but also of some of the most interesting and least known. Therefore any study of these glaciers promises important results, and studies of one year will serve as a basis for future comparative studies. From this latter standpoint it has seemed to us highly important not only to provide descriptions of glaciers, but also to prepare maps of such detail as to give an accurate basis for future comparative study. Accordingly, the topograhper of the expedition, Mr W. B. Lewis, whom the U. S. Geological Survey detailed for this work, assisted by Mr E. F. Bean, has made a series of detailed contour maps of the principal glaciers studied. These will be published with our final report. Supplementary to maps, photographs from

THE ADVANCING MARGIN OF ATREVIDA GLACIER BROKEN BY RECENT FORWARD MOTION

In 1905 this was a moderately sloping, moraine-covered ice margin; in 1906 it was a jagged cliff from which blocks of ice and stones were constantly falling into the forest, which was being overwhelmed (see pages 17 and 29).

selected points, which can again be occupied, are of high importance. The expedition was fortunate in having the services of Mr O. D. von Engeln, a skilled photographer trained also in physiography, to the results of whose work we are much indebted; and his photographs taken during this expedition as well as those which he took on the expedition of 1906 will be of great value in all future work on these glaciers. To these three men the authors are especially indebted for careful, conscientious work in their fields, as well as for generous assistance whenever and wherever needed. All future students in these fields will profit from their excellent work.

The glaciers of the Alaskan coast are especially interesting to the student of continental glaciation because here large masses of ice descend into a cool, damp, temperate climate, much as was the case at the base of the Alps and other mountains during the Glacial period. The wasting margins of these glaciers furnish much information of value in the study and interpretation of the phenomena of continental glaciation in Europe and

NUNATAK GLACIER IN 1899 (PHOTOGRAPHED BY G. K. GILBERT)

NUNATAK GLACIER TEN YEARS LATER

Photograph by the National Geographic Society's Expedition from exactly same site, glacier having retreated out of sight (see pages 8 and 44)

LUCIA GLACIER IN 1909 FROM TERRACE POINT

It is crevassed and moving rapidly. In 1890, 1905, and 1906 it was stagnant and without crevasses. The nunatak in the background is being overridden (see pages 24–25)

VIEW OF HIDDEN GLACIER IN 1909, TAKEN FROM SAME POINT AS THE PICTURE SHOWN ON PAGE 43 (SEE PAGE 26)

HIDDEN GLACIER IN 1906

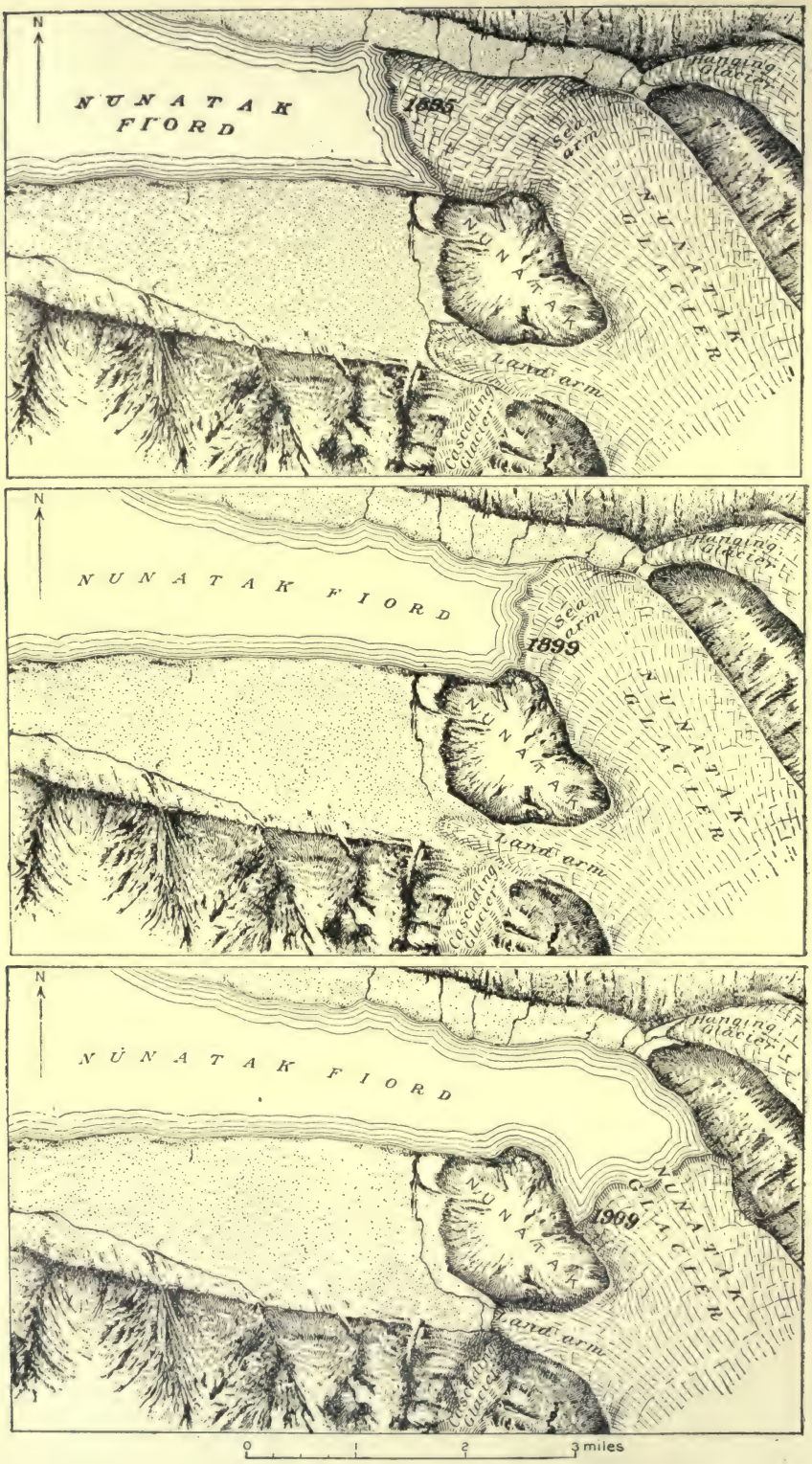
This photograph was taken from the same point as the view of Hidden glacier in 1909, given on page 42. The glacier has advanced nearly two miles in three years

America. In our expedition especial study was made of the piedmont ice bulbs into which so many of the glaciers expand on emergence from their mountain valleys; and in this connection the ablation moraines which accumulate on the wasting surfaces of the stagnant piedmont ice masses, and the deposits accumulating around their margins, were given particular attention. A statement of the results of these studies must for the present be postponed.

Another line of inquiry to which attention was given was the cause of glacier motion, upon which the advancing glaciers throw light. The sudden forward movement of a glacier, such as observed in Yakutat Bay, is difficult to explain on the basis of some of the current hypotheses for glacial motion. On the hypothesis of plastic or viscous flowage, on the other hand, the phenomena are all easily explained. A number of facts of observation in the summer of 1906 and 1909 tend toward the verification of this hypothesis. The discussion of this subject must also be left for our final report.

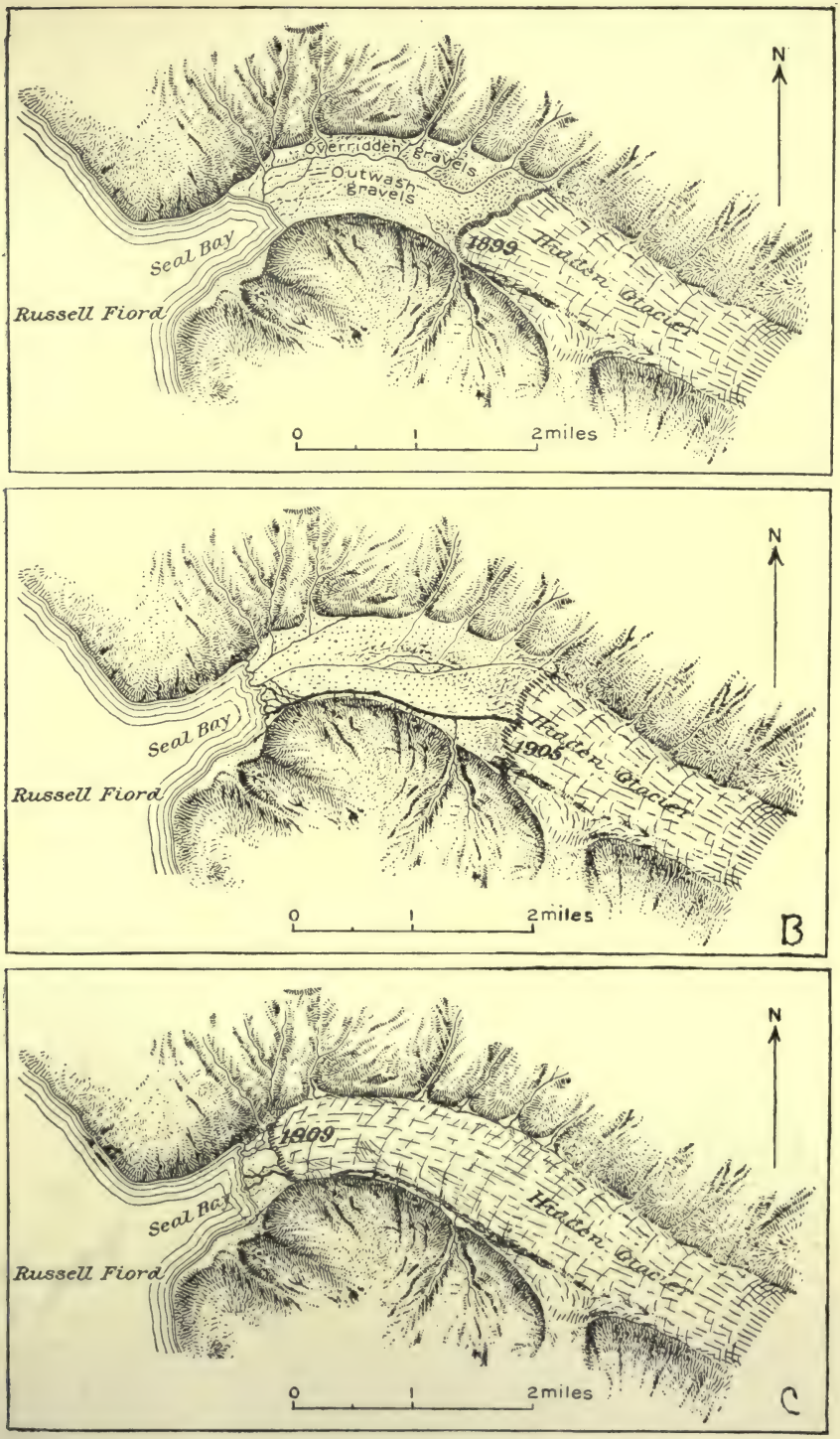
Other problems which will be discussed in the full report deal with questions relating to the former extension of the glaciers. During the period of maximum glaciation, ice filled the entire Yakutat Bay inlet and discharged icebergs into the Pacific; and at the same time the Copper River Valley was filled, and ice occupied the entire Prince William Sound, at least on the eastern side to which our studies were confined. The erosive work performed by these great glaciers has, in part, shaped the various inlets and valleys, while their deposits have left records of considerable scientific interest.

In view of the fact that only two parts of the coast have so far been studied, it will not, of course, be possible to enter into a comparative study of the phenomena of former glaciation of all



NUNATAK GLACIER IN 1895, 1899, AND 1909 (TOPOGRAPHY AFTER GANNETT)

This has had continuous steady retreat, but may yet advance under the earthquake-avalanche impulse (see page 40)



HIDDEN GLACIER IN 1899, 1905, 1906, AND 1909 (TOPOGRAPHY AFTER GANNETT) (SEE PAGES 26, 42–43)

BROKEN EASTERN MARGIN OF THE MARVINE LOBE OF MALASPINA GLACIER, FROM ALLUVIAL FAN OF KWIK RIVER (SEE PAGES 17 AND 28–29)

The broken ice cliff has protruded through the morainic soil and the forest. Blocks of ice fell from this cliff as the party passed, trees crashed down, and the morainic soil was constantly sliding down. Photograph taken August 11, 1906.

BLOCKS OF ICE PROTRUDING THROUGH MORAINIC SOIL AND FOREST COVER, EASTERN MARGIN OF MALASPINA GLACIER (SEE PAGES 17 AND 28–29)

Cottonwood trees, in full leaf, overthrown by the recent thrust that broke the glacier margin. Photograph taken August 11, 1906

THE SURFACE OF MARVINE GLACIER IN 1906, SHOWING THE DEEP CREVASSES WHICH MADE ITS CROSSING IMPOSSIBLE

The National Geographic Society's Expedition three years later, 1909, found these crevasses healed and the surface comparatively smooth and easy of traverse (see pp. 17 and 28-29)

Alaska; but enough has already been seen to make it possible to compare two widely separated regions, and to show that their glacial history has been different. While in both cases ice formerly extended beyond the present limits, the Prince William Sound and Copper River regions have not shared in an important episode of recent great ice advance, of which the evidence is so clear and convincing in Yakutat Bay and Glacier Bay. Why one part of the Alaskan coast should have been favorable to an advance of glaciers to a distance of many miles, and then to recession of these glaciers, while another part gives evidence of no such oscillation, is an interesting question. Other notable differences in glacier condition are also found, such, for example, as the difference between Columbia glacier, which is now farther out than it has been for at least a century and is still advancing, and the Valdez, Nunatak, Muir, and other glaciers, which are now greatly shrunken as compared with their condition a few years ago. Some of these problems cannot be adequately discussed until a wider area has been studied and a greater body of fact accumulated.

In conclusion, the authors wish to express their opinion that the problems of Alaskan glaciers and glaciation present a field for geographical research of the very highest scientific importance. In so large a field not all the glaciers, and in

GALIANO GLACIER (SEE PAGES 14 AND 59–62)

This picture represents in miniature all the conditions of the Malaspina glacier. The white snow fields in the background are constantly feeding the glacier, while in the foreground the ice has been so thickly covered with earth and rocks from the mountain sides that sturdy shrubs have grown up and make it difficult to believe that only a few feet beneath is the solid glacier ice.

MORAINE-COVERED FORESTED EASTERN MARGIN OF THE MARVINE LOBE OF MALASPINA GLACIER

The ice, recently thrust forward, has protruded through the soil; the trees are tilted at various angles and overturned; and the underlying ice, exposed to air and rain, is rapidly melting. Streams of water and of liquid mud descend the slope.

fact not all the larger glaciers, can be given careful study for years to come; for not only are there hundreds of such glaciers, many of which are still unnamed, but large numbers of them are so inaccessible that they can be studied only by special expeditions, expensive from the standpoint both as to time and of money.

While ultimately it is to be hoped and expected that all of these glaciers will be studied and mapped, the present needs can be met by a study of a few selected areas in which it is to be expected that the principal phenomena of Alaskan glaciation will be exhibited, and from which facts can be observed which will solve some of the larger problems and furnish basis for future study which will solve others.

In selecting these areas first consideration should be given to the scientific promise; second, to the variety of phenomena, and third, to the expenditure of time and money. From the latter standpoint accessibility is the key. Alaska is being rapidly opened up by road and railway building and river navigation, and what is today quite inaccessible, may in a few years be easy of access; therefore it seems hardly wise, in view of the broad field of opportunity, to expend large amounts of time and money in a study of what a few years hence may be reached with ease in far less time and at a far less expense.

ADVANCING ALTREVIDA GLACIER IN 1906 (SEE PAGES 17, 28–29, AND 39)

Showing the deep, impassable crevasses which are characteristic of a glacier during its advance

ALTREVIDA GLACIER IN 1909 FROM SAME SITE

Showing crevasses healed and surface covered with ablation moraine, an accumulation of earth and rocks from the mountain slopes (see pages 17, 28–29, and 39)

THE RESURRECTED FOREST: NEAR MUIR GLACIER

Photo from "Harriman Alaskan Expedition." Copyright, 1902, by E. H. Harriman

COLUMBIA GLACIER IN 1899

Photo from "Harriman Alaskan Expedition." Copyright, 1902, by E. H. Harriman (see also pages 30–33)

In view of the promise which this field of research holds forth, and of the considerations just stated, the authors have set themselves the task of outlining what seems to them a desirable program for the study of Alaskan glacial phenomena, so as to bring forth the results which seem to them most important, as follows: (1) Annually for several years a brief visit to Yakutat Bay, perhaps combined with a further study of Malaspina glacier if the advance of its tributaries permit travel over it, a study of the large glaciers of the Alsek valley, the Fairweather coast, etc.; (2) a more detailed study of the glaciers of Prince William Sound and the lower Copper River Valley; (3) the glaciers of the Inside Passage from the Canadian boundary to Cross Sound and the Muir Inlet; (4) the Controller Bay region, and the great piedmont Bering glacier; (5) the glaciers on the north side of the Saint Elias Range and in the Mount Wrangell region; (6) glaciers and glaciation in the great Alaska Range, the Endicott (Rocky) Mountains, the Alaska Peninsula, etc. If such work could be carried on consecutively, as part of a matured plan, the highest results for comparative purposes would be secured; it would be a notable contribution to science if the National Geographic Society should undertake an investigation of this scope.

PHOTOGRAPHY IN GLACIAL ALASKA

By O. D. von Engeln

Photographer of the National Geographic Society's Alaskan Expedition of 1909

ALMOST every subject of geographic interest has one or more phases of which photographic records can be made. It may therefore be inferred that a large number of the readers of the National Geographic Magazine are photographers, and that many of them are engaged in the fascinating task of carrying the camera into the remote places of the earth, as the pages of the Magazine itself testify.

The opportunity to focus a lens on scenes hitherto unpictured is compensation in itself, but an equal interest in such work lies in the difficulties which must inevitably be encountered and overcome when working with the camera away from the conventional dark-room, with its electric ruby-light and other conveniences. To "bring out" a collection of good negatives under such conditions becomes a worth-while task, and one which is in few places more difficult, probably, than in glacial Alaska, especially from that part of this region which is its focal point—the coast along the center of the great Gulf of Alaska.

It has been the privilege of the writer to do the photographic work of two expeditions to this region—that of the National Geographic Society's party of the past summer, and, in 1906, with a United States Geological Survey party. The following paragraphs have been written in the belief that the experiences recorded may be of interest and value to others who are engaged in similar work.

The photographer on a trip to Alaska will find subjects for his camera on the first morning after the sailing from Seattle in the personnel of the passengers. It must be understood that this does not apply so particularly to the excursion steamers, which carry tourists to the interesting points along the Inside Passage, but refers more especially to the boats which carry both passengers and freight to the mining towns and fishing stations scattered along the southeastern and southwestern Alaskan coast, with longer stops at the coast terminals of important routes to the interior mining fields. The second-class passengers on such a steamer are in the main typical

Alaskan "sour-doughs," old-timers, but include a few new-comers or "chechakos." The "sour-doughs" are characters of the greatest interest, representing as they do the last of the American pioneers to westward. The Scandinavian type predominates—men of splendid build, whose eager, alert attitudes as the boat approaches each Alaskan village afford good subjects for the kodaker.

The cabin passengers present more diverse types. Mining, railroad, and construction engineers; successful prospectors; capitalists, judges, and commissioners; scientific men in the fields of geology and forestry; store-keepers, cannery managers, and perhaps a writer or two, make up their number. These are more shy of the camera man, but from their conversation one may acquire an all but complete history of Alaska and the current events of its present-day rapid development.

In passing through the narrow reaches of the Inside Passage, such as Grenville Channel, the photographer is offered many opportunities, from the deck of the vessel, for pictures of the steep, glaciated cliffs of these passages among the islands. Waterfalls, sometimes extending all the way from a high mountain summit to the sea, but more often emerging from the lips of hanging valleys high up on the slopes, descend between the sheltering green of the luxuriant vegetation which everywhere covers the mountain sides, the water in each case appearing as slender threads of foaming, white, high-light.

The first opportunity, however, for securing a truly imposing picture is afforded by the lofty peaks of the Fairweather Range, all snow-covered, with valleys buried in glacial ice, and towering from 10,000 to 15,000 feet straight up from the sea-level. These mountains are to the northward of the Inside Passage, and the ship is from 10 to 15 miles out to sea while they are in view. A good picture is, therefore, contingent on a clear day and a suitable lens; that is, a lens with sufficient length of focus to enable one to get a large image of the distant peaks on the ground glass.

For such work a telephoto lens is usually recommended, but I have found these very unsatisfactory, because the very small aperture at which they work makes focusing very difficult. In this case it would render their use impossible, as the motion of the steamer would preclude an exposure of the necessary duration. A rapid rectilinear lens, furnished by Bausch and Lomb, of 17½-inch equivalent focus, working at f/16 and fitted with a shutter having a maximum speed of 1/100 second, was found admirable for all kinds of distance work.

The other great peak and mountain range visible from the steamer, as one sails to the north and westward, is Mount Saint Elias and its setting, the latter sometimes inaccurately termed the Saint Elias Giant Alps. Although Mount Saint Elias rises directly from the low ice-plateau of the Malaspina glacier, it is so far distant from the sea that imposing pictures of its pyramidal mass are difficult, if not impossible, to get. One opportunity for a striking snap-shot was missed (because the cameras were stowed away) on the first evening after our landing at Yakutat. That was at the last of June, and the sun set directly behind the peak, outlining it in fire and at the same time casting a triangular shadow of the mountain on the sky, high above the summit. The sky-space between the mountain and its shadow was filled with the varied colors, lights and shadows of the sunset glow, while in the foreground the lower mountain ranges gleamed white in their all-enfolding mantles of snow.

Such opportunities for photographing the peaks of southeastern Alaska are rare, because of the almost continual presence of clouds, and the steady downpour of rain for much of the time on the lowlands. Again, it is the rain and the consequent humidity which make photographic processes so difficult. On the other hand, the same humid conditions provide the snow-fall on the higher ranges, which, in turn, gives rise to the glaciers, on whose presence is dependent much of the pictorial interest of the region.

WASHING FILMS IN SEA WATER AMONG THE ICEBERGS: "EVERY NEGATIVE ON THE STRIP PERFECT"

The experience gained in the summer of 1906 made it possible to plan to meet the conditions more adequately in 1909, but the hurried outfitting which circumstances necessitated left no time for trying out any of the outfit, and, in fact, gave no opportunity for the inspection of much of it until we arrived in the field. In consequence it was found, for example, that the front board of the plate camera was not accurately centered, and many pictures were taken which were slightly out of focus on one side before this defect was noticed and rectified as well as possible with the tools available in the field. It is possible that this defect was caused, or aggravated, by the moisture of the air causing the wood of the camera-box to swell and draw. In any case, a difficulty such as this illustrates the value of a careful try-out of apparatus before taking it into the field. It may be worth while to remark, in this connection, that in testing a kodak or other hand camera it is well to see that the focus for the 100-foot point of the scale, or infinity mark, has been accurately marked and gives sharp and clear negatives.

The difficulties attendant on loading plate-holders under blankets (especially as it is light all through the night at this latitude in early summer) experienced on the previous expedition led to the purchase of the only *dark-room tent* which could be found listed in the available catalogs. This tent, when examined in the field, proved to be an affair about 8 feet high and square, made up of black duck with a lining of red cotton cloth, the whole sewed up into a cube-shaped sack which fitted over four corner-posts and laid on a framework tying the posts together.

The flat top of this contrivance would not shed rain, and, as we had no extra fly, it was necessary to push up the top with a center pole. Its ungainly appearance earned it the name of the "dog kennel" when first set up. Moreover, the light which filtered through fogged plates only momentarily exposed to it, and, as the black duck faded almost immediately to a dingy brown, it soon became altogether unsafe, and the old blanket expedient had again to be resorted to. However, it served as an outer protection, making it possible to load plates "by feel" inside a lidless grocery box set up on end and lined and heavily curtained with black cloth.

It seems to the author that it would be a both profitable and appreciated enterprise for some photographic supply-house to undertake the manufacture of a trustworthy dark-room tent for use in the field. Such a tent need not be large, but it should have high walls, and, if this necessitates a flat top, be provided with a fly. The outer covering should be of some water-proof material, such as is used for buggy curtains, and it should have a lining of fast-dyed red cloth. If the outer covering of such a tent were torn, under camp usage, it could readily be mended and rendered light-tight by the use of adhesive tape. A tent of this kind would make the loading of plates and their transference from the plate-holders to the developing solution both safe and convenient. The many scientific parties which are working in Alaska should alone make the enterprise profitable.

The greatest pleasure of the summer's work was afforded by the convenient method, and the highly successful results attained by the use of the Eastman Kodak Company's film and plate tanks. Again and again the films came out of the tank every negative on the strip perfect. Where this was not the case the fault was very clearly shown to be with the man who made the exposure.

The same thing was true of the plate tank, but in minor ways this has not been perfected to work so conveniently as the film apparatus. There ought, for example, to be a series of perforations along the edges of the bottom of the plate-carrier, so that the end plates would receive a better washing before transference from the pyro developer to the hypo bath. As it is one must rinse very carefully to avoid getting pyro stains on the end plates. This trouble can be

avoided, however, by rinsing and transferring to the hypo bath in the darkroom, when there will be no opportunity for the action of light while the developer is still on the plate.

Photographers are accustomed to messing in cold water, but most will agree that an average temperature of 44 degrees Fahrenheit for washing waters does not add particularly to the zest of the pursuit. Melted snow, mountain brook, and sea waters alternately served the photographer's purposes. Nor was it always possible to bring the temperature of the solutions to the desirable mean of 60 degrees. Yet the results for time of development as given in the manual were uniformly good. Unless one cares for dense negatives it is well to remember that the time of development must include the time required to remove the lid of the tank and to pour off the developer. A most convenient method of washing is to place the strip of film, or the plates in their carrier, in a bucket or tank, and weight this to the bottom of a pool in a clear, swift-flowing stream.

To combat the excessive moisture of the region (it sometimes rains constantly for a week, day and night, and if there are two clear days in seven one is in luck) we adopted various expedients. Film packs as large as five by seven inches get out of plane under these conditions, so we carried glass plates. These we kept in a specially constructed box, which had a clamping, rubber-sealing device to render it as nearly moisture-proof as possible. As an additional precaution a quantity of calcium chloride was kept in the box with the plates.

The films were kept in sealed tin cans. After attempting, unsuccessfully, but without spoiling it, to dry a strip of film in the tent, a soaking in grain alcohol was resorted to, and drying in a short time resulted. To use the alcohol effectively it is necessary to immerse the plates or films for at least ten minutes, and, if the gelatine shows a tendency to frill, to admix about 1 per cent of formaldehyde.

A surprising thing, when first encountered, was the short exposure required when photographing in glacial regions. One-hundredth of a second, with a stop of f/6.3 sufficed on overcast days, and on a day only slightly hazy the same exposure with a stop of f/11 was ample. This is accounted for by the enormous amount of actinic light which the blue glacier-ice, the water, the white snow of the mountain peaks and the rock slopes, which latter are bare of vegetation near the glaciers, reflect on all sides. It is to be remembered that diffused light is the most actinic—that the blue of the sky is in fact due to this diffused light. Making a panorama from the white ice-top of the Hidden glacier, the lens had to be pointed directly toward the sun, and the picture included snow-covered mountains and the sunlit sea—surely a chance or two for halation and fog.

The necessity of securing all the record pictures required by the scientists, and the limited number of clear days available for camera work in this region, are conditions which combine to restrict very narrowly such aspirations as the photographer may have for doing pictorial work. The record pictures must be taken with more regard to encompassing all possible detail than to the effectiveness of the composition. Again, the scientific notes and observations at any one site generally require much less time to secure than is necessary for the exposure of the requisite number of plates. The party is, therefore, ready to move on as soon as the photographer has once more shouldered his camera and tripod.

To focus on the gleaming front of some tidal glacier, whose ice-wall is perhaps 300 feet high, and wait deliberately for the chance to snap the birth of an iceberg as it is detached from the parent cliff and falls with a thunderous crash into the sea—that is a craving that has possessed me on both trips, but was never satisfied. We many times witnessed the spectacle, but there was no opportunity to photograph it from a near-by site.

Mentioning the thunderous crashes which announce the birth of new ice-

bergs recalls an idea I had one evening when we were encamped on the west shore of Yakutat Bay. This was to the effect that a city photographer ought to feel perfectly at home in glacial Alaska. The Arctic wilds have been termed the "silent places," but no phrase could have been farther from the truth as applied to this time and place. The rain was beating upon the side and top of the tent, and the wind kept snapping its loose flap endlessly.

In front of the tent the surf roared in ascending and diminishing crescendos, sending surge after surge over the iceberg-littered sand beach. Farther out in the bay the occasional breaking up and overturning of a big iceberg gave rise to a continuous sound like the rattle of a near-by express train. At rarer intervals one heard the distant boom, like that of a big gun, sent forth by the detaching of an iceberg from the glacier front.

Nor was this all. To one side of the tent a mountain torrent came rushing across the flat, while from the mountains in the rear one heard the low rumble of avalanches among the cascading glaciers occupying their steep valleys. The combination, and simultaneous occurrence, and continuance of all these noises gave rise to a very pandemonium of sound, and of a volume which would easily overtop the roar of the busiest of busy city streets at the height of the day's activities.

THE PHOTOGRAPHER'S PACK

While the pictorial interest of the scientific-record pictures often suffers because the point of view must be chosen with more regard to showing the detail of some particular phenomenon than to the composition or the character of the foreground, still there are opportunities for securing many striking effects in a country of such scenic magnificence, even though the pictures are to have their chief value as records. Sometimes, too, a whole geological story may be included in one picture, as is the case of the photograph of the Galiano glacier reproduced on page 48 of this Magazine.

This illustration is unique in that it reproduces a view where are shown in miniature all the conditions and phenomena of the extensive and famous Malaspina glacier and its feeder tributaries. On the mountain summits of the back-

LOOKING SEAWARD FROM THE HIDDEN GLACIER

Camera pointed directly toward sun. Snow, ice, clouds, sea, and mountain summits in one view, detail in all and no halation (see page 58; also page 42)

HIDDEN GLACIER, LOOKING SOUTHEAST: A STUDY IN GRAYS (SEE PAGE 58; ALSO PAGE 42)

ground are the snowfields, giving rise to a series of cascading glaciers, typically crevassed, which flow down the steep slopes of the cirque-like valley. The contributions of these cascading glaciers form the main stream of the valley glacier below, showing white, crevassed ice at its upper end. As this glacier emerges from between the mountain walls, however, it expands, its crevassing disappears, and in the middle distance of the picture the ice surface is already thickly mantled with ablation moraine (an accumulation of earth and rocks). In the immediate foreground the ablation material has buried the ice so deeply that one would hardly suspect that there was ice underneath. Vegetation has gained a foothold, and the only sign to betray the inert glacier below is the occasional slumping induced by its very slow melting.

In Yakutat Bay and its extensions there is, except on the low ocean foreland, an entire absence of forest growth—a condition accounted for by the recency of the glaciation. When working here the outdoor photographer comes to realize how much he is dependent on trees to lend grace and softness to his compositions. The succession of pictures that he secures in this wonderful region are monotonous, harsh, and forbidding, because they so much lack the soft shadows and the graceful contours furnished by the forest citizens of other climes.

In Prince William Sound, however, especially in the region about the Columbia glacier, a forest of spruce and cedar advances close to the ice margin. A thick turf of peat covers the floor of these woods, and this peat in turn is dotted with little lakelets which have their edges hemmed with bright flowers. When climbing the slopes of the mountains of this neighborhood one is afforded most interesting vistas of water, woods, ice, and snow through the forest glades and lanes.

I have been informed that Curtis, the famous photographer of Indians, intends eventually to picture the Alaskan natives. He will find some very interesting material in the neighborhood where we worked. At Yakutat, however, the Thlinkets have been in contact with the white man so long that typical studies are difficult to secure. At Dry Bay, a village to the south, a tribe of the same nation still live in their primitive environment, and probably do not demand a fee of "two bits" (25 cents) when asked to pose, as is customary at Yakutat. If the fee is not forthcoming the women will cover their faces and run. The children, however, are more docile and afford some interesting studies.

To the untutored mind this desire on part of the white man to secure many pictures of everything with which he comes in contact must present a perplexing problem. This was indicated by the attitude of our Japanese cook. On each favorable day we would leave camp early in the morning, taking with us our cameras and instruments. But on our return late in the evening we brought back no gold or trophies of the hunt. The cook's curiosity was aroused to such a pitch that he begged permission to accompany us on one of our trips. This proved to be a hard morning's work, climbing over mountain spurs and struggling through alder thickets. At noon we came to a glacier front, set down some notes, exposed a number of plates, ate a light luncheon, and prepared to return. That was too much for the cook; he burst out: "Walk so long—so hard trip—only picture take! Mak' me sick!"

In conclusion I would emphasize this caution: Do not attempt to carry exposed but undeveloped plates or films back to civilization from a region whose humidity is equal to that of the southeast coast of Alaska. Only a few will develop up as perfect negatives. Most will be mealy, or, worse, be peppered with opaque spots the size of a pinhead, whose origin is difficult to explain. Develop in the field, and as soon as possible after exposure.

THE DISCOVERY OF THE NORTH POLE

THE principal feature of the Annual Banquet of the National Geographic Society, December 15th, was the presentation of a special gold medal to Commander Robert E. Peary, United States Navy, for the discovery of the pole, and of Hubbard medals to Captain Robert Bartlett for attaining the farthest north, and to Grove Karl Gilbert for achievements in physiographic research. Telegrams of congratulation were read during the evening from former President Theodore Roosevelt, who, on behalf of the Society, presented the Hubbard medal of the National Geographic Society to Commander Robert E. Peary in 1906; from the Duke of the Abruzzi, and from the Geographical Society of London and the Geographical Society of Berlin.

About five hundred members and guests attended the banquet, including representatives from many foreign countries and from all parts of the United States. Toasts were responded to by the Dean of the Diplomatic Corps, the Italian Ambassador, Baron Mayor des Planches; the French Ambassador, Hon. J. J. Jusserand; the British Ambassador, Hon. James Bryce; Speaker Cannon, Andrew Carnegie, Admiral Colby M. Chester, Professor J. Howard Gore, General Thomas Hubbard, President of the Peary Arctic Club, and Hon. John Barrett.

The medals have been inscribed as follows:

> A Special Medal Awarded by the National Geographic Society to Robert E. Peary for the Discovery of the North Pole, April 6, 1909.
>
> The Hubbard Medal Awarded by the National Geographic Society to Robert A. Bartlett, Commander of the S. S. *Roosevelt*, for attaining the Farthest North, 87° 48', March 31, 1909.
>
> The Hubbard Medal Awarded by the National Geographic Society to Grove Karl Gilbert for original investigations and achievements in Physiographic Research during a period of thirty years.

The telegrams received were as follows:

NAIROBI, *December* 12, 1909.

National Geographic Society, Washington:

Extremely pleased. Desire through you to extend heartiest congratulations Peary on his great feat which you have thus recognized.

ROOSEVELT.

LONDON, *December* 15, 1909.

National Geographic Society, Washington:

Hearty congratulations to Peary on medal. Highly gratified at medal to Bartlett.

DARWIN,
President, Royal Geographical Society.

BERLIN, *December* 15.

COMMANDER PEARY,
National Geographic Society, Washington:

The Geographical Society of Berlin sends to its honorary member heartiest congratulations on these honors well deserved because of your conquest of the pole which is rich in results, and hopes early in the spring to be able to similarly honor you here.

WAHNSCHAFFE, *President.*

THE TOASTMASTER, WILLIS L. MOORE, PRESIDENT NATIONAL GEOGRAPHIC SOCIETY

On behalf of the Board of Managers of the National Geographic Society and of the fifty thousand and over members of the organization, and especially of the three hundred and fifty members of the Society gathered at these tables tonight, I extend to you, our guests, a hearty greeting. We are met to celebrate a great achievement. This is an Arctic night at the pole. But we trust that the fervor of our greeting for you will be tropical in its significance.

And with that word of greeting to you we will begin the exercises of the evening, and we shall endeavor to dismiss the gathering within a reasonable time. That is a little intimation that we do not expect very long speeches from any particular individual. I will make exceptions to that on the part of the three Ambassadors on my right and left. They cannot talk too long for the National Geographic Society. One comes to us from that nation that has given so much

to the world in literature and art, the mellowing influence of its beauty and antiquity shedding a soft refulgence throughout the entire world. A member of the royal family of that nation was entertained in this very room three or four years ago, who has achieved great honor in Arctic exploration, and we have a word from him tonight. I shall introduce the Ambassador from Italy, Baron Mayor des Planches, to say a few words and give us that message. The Ambassador from Italy.

THE ITALIAN AMBASSADOR—BARON MAYOR DES PLANCHES

Mr President, ladies and gentlemen: I remember having been present at another banquet given by the National Geographic Society, in which Commander Peary was, as he is now, the guest of honor.

Commander Peary had already at that time reached the highest polar latitude, beating the record of a young Italian explorer, the Duke of the Abruzzi. I had not, then, special instructions to congratulate the Commander for the splendid result he had already obtained, but I was sure that His Royal Highness, chivalrous as he always is, was applauding the achievement of his fortunate rival. I expressed to the winner the felicitations of the defeated, and the Duke afterwards cordially approved of what I had done.

Now things are different. As soon as I received the kind invitation of your President to be here tonight, I cabled to the Duke that I would have the pleasure of meeting the glorious conqueror of the pole. A few hours after I received the cablegram which I ask your permission to translate:

"Many thanks to you for giving me the opportunity to express to Commander Peary my heartfelt felicitations. Tell him in my behalf that I am happy that the pole has been discovered by the explorer whose courage and perseverance deserved such a reward.

LOUIS OF SAVOIA."

THE FRENCH AMBASSADOR—HON. J. J. JUSSERAND

Mr President, ladies and gentlemen: Two years ago we were gathered together, almost day for day, in this same room, under the same chairman who has just spoken in such touching words of my country, and such undeserved ones of her representative; and we were gathered together also to commemorate a pole discovery. It was the discovery of the magnetic pole. I was asked to say a few words. Offering to you excuses for quoting myself, I beg permission to recall that, considering the time to come, I expressed myself thus: "Some new expedition, led through air or through water, by some maybe among the men present here today, will certainly, in the near future, gain the first sight of the long-sought North Pole." And looking at the list of those present on that day, I find that there appeared the name of "Commander and Mrs Robert E. Peary." I think I may say that, once in my life, I spoke as a prophet.

Momentous changes have come to pass in the world and in this land. For a very long time, during the period to which our chairman alluded just now, America was not the land that produced explorers, but the land for explorers to seek. The day in August, 1492, when a certain Spanish ship left Palos and floated across the unknown sea, resulted in the revelation to wondering nations of a new, unsuspected, and immense world; and the energies of all those who wanted to discover, to learn, to win, to explore, to get fame and wealth for themselves and their country, were bent for centuries toward this continent more than toward any other part of the globe. The ocean was crossed and recrossed by the tiny crafts of some of the best sons of France, England, Italy, Holland, Spain, Portugal, Scandinavia. We French certainly did our part, as we explored further inland than any, and made known to the world the resources and beauty of the valley watered by the "Mechacébé."

For a very long time, indeed, it was the desire of the pluckiest to come to these shores and explore those new regions so extraordinary, so beautiful, yet so thoroughly unknown that it took till our own lifetime to get a somewhat accurate idea of their contents. Many of us were already in our manhood when the Yellowstone Park was revealed to the admiration of the world.

But before that moment a great change had taken place; the field for exploration had begun to produce explorers, and it has never ceased since; explorers of unknown lands, like Rockhill, Crosby, and many others; explorers of the depth of the seas, like Agassiz; of the realms of electricity, like Graham Bell and Edison; of the sun, like Doctor Hale; of ancient Babylonic civilizations, like those scientific missionaries sent abroad by the Chicago University, and explorers, above all, of that unknown world into which French Montgolfier was the first to rise, the world of air, mastered by the plucky men of our day, in the front rank of whom stand your famous compatriots, the brothers Wright.

And while so many explorations went on, one remained ceaselessly striven for, ceaselessly unachieved: the one that had for its object the conquest of the pole. The longing for that discovery is of a comparatively recent date, but once its hold on mankind began, it proved one of the most ardent men had yet experienced.

The ancients had not evinced any great anxiety about the polar regions. They knew the north was a strange frozen place with weird legends about it, a region, said Tacitus, where looking toward the east one can see Phœbus rise: "The sound he makes on emerging from the waters can be heard, and the form of his steeds is visible."

In the last century, the problem became for mankind one of intense interest, one which *had* to be solved, were it, as indeed it was, at the cost of many an heroic life. And the great labor began, never to be interrupted until could be possible such a gathering as today's, in which the National Geographic Society of America is to bestow its medal on the now most famous of its members. Long was the search and hard was the toil, from the days of Sir John Franklin and Kane to those of Nansen, Nordenskiold, royal Abruzzi, and your admirable Greely remaining three years unrevictualed in the frozen north.

I well remember how, in days long past, I followed as a child, with my brother and sisters, our hearts beating with emotion, the efforts of one of the imaginary heroes of that prophet-novelist, Jules Verne; a prophet-novelist indeed, for most of what he fancied has become reality; his fancy submarines have become our real ones, the world he announced where everything would be done by electricity is now near at hand; his dream dirigibles have become our tangible ones, and the conquest of the pole, which he foresaw, is now a fact. He described it in advance, and not so badly, for he told us that, at the pole, there was no land, but only sea, and Commander Peary has just returned to tell us that it is so. Truth to say, the writer asserted that the sea was an open one, and I have present in my mind, as if it were a thing of yesterday, a view of that open sea pictured in his book, and along its shore quantity of birds, the like of which, I am afraid, Commander Peary had not the satisfaction of killing and eating. But as you know, there is no prophet so good that does not make now and then some little mistake.

Well, after that long search, and so many proofs of endurance and valor given by many, the deed is done and the coveted prize belongs to you, Americans. If we, French, did not do much for the solution of the problem, busy as we were, and usefully busy, exploring elsewhere in Asia, Africa, South America, we know full well what peerless merit there was in doing what your compatriot has accomplished, and about which what there is to say is going to be expressed by our learned chairman tonight. Commander Peary will allow me to offer him a tribute of admiration, and the congratulations of my country for the fame he

has won and the deed he has accomplished.

THE TOASTMASTER

We have at our tables many representatives from our National Congress from both houses of that great body. We mean no disparagement to the legislative institutions of any other country when I say that the American people have a proper reverence and respect for their own representatives. I do not believe that there is a cleaner, an abler body of national representatives met anywhere in the world than the National Legislature of the United States. We are honored tonight by having at our board the Speaker of the House of Representatives. People do not apply an endearing term to a public man that they do not down deep in their hearts respect, and I shall, as an honor to the National Geographic Society, ask the Speaker of the National House of Representatives to say a word at this board.

SPEAKER CANNON

Mr President, ladies and gentlemen of the National Geographic Society, and guests: It is supposed that the present incumbent of the Speaker's chair is a czar. Such being the case, the rules of the House in committee of the whole on the state of the Union will be enforced; that is, the five-minute rule. Note the time and let your gavel fall at the end of five minutes, unless I leave the floor earlier than that.

I am glad to be here. I am glad that the National Geographic Society have settled one thing. Peary or Cook found the North Pole, and you stated which, and I have implicit confidence in your judgment. How marvelously the nineteenth century has witnessed the opening of events which three hundred years prior thereto the nations of Europe sent in their colonies to the new continent to struggle for mastery. Their bones are dust and their souls are with the saints, but the coming of the French and the German and the Scandinavian and the inhabitants of Great Britain, and the present coming of the Italians and the Hungarians, and the Spanish who came first and wrought great things in the new continent, have settled all questions. We are glad to congratulate ourselves in the United States that we have the most enterprising and of the best of those countries that have made our own country their country, and have been assimilated and form our civilization. You cannot sing the *Banzai* national air, you cannot sing "The Campbells Are Coming," you cannot sing "The Watch on the Rhine"—which always seemed to me in comparison with all the other music like the grinding of a great glacier—you cannot sing them anywhere in the boundaries of the Republic but what the huzzas will come. How marvelously the progress!

I am but yet a young man, and yet I recollect very well when it was gravely proposed in the Senate of the United States that a statue should be erected to the god Terminus on the peaks of the Rocky Mountains, and that should be our western boundary. All questions of territory have been settled, and the United States is the common territory of what we can gladly say is the best blood of the European countries. I say best blood because the enterprising young men come to new countries that promise in their judgment a reward for their enterprise and courage. I am glad that the North Pole has been found. I am glad for many reasons. In the first place it will stop adventurers after notoriety or adventurers in fact from endeavoring to discover the pole. We know now whether there is land there, and I am glad to know there is no land there and I can prove it by Peary, because there is no chance for any discussion about the conservation of natural resources. There can be no ice factory, because it is brackish and the ice would be worthless.

I am glad to be with this Society. I have had many invitations. It has so happened that this is the first one that I have been able to accept. But, after looking into your faces and congratulating you over the history of this Society—over the founder of the Society, who has

crossed over, but his work is still with us—and after congratulating Commander Peary, I pay my respects to the representatives of the many great governments here tonight and will just in one sentence sit down. When next, Mr President, John Gilpin rides, may I be there to see.

THE TOASTMASTER

Many of our guests are familiar with the aims and objects of the National Geographic Society; all are not, and so I shall introduce for a few minutes our Professor J. Howard Gore, Professor Emeritus of George Washington University, a member of the Board of Managers, to tell you something of the aims and objects of this institution.

THE NATIONAL GEOGRAPHIC SOCIETY—BY JAMES HOWARD GORE

In some future edition of the Book of Proverbs it may be written: "Whoso tooteth not his own horn, yea verily the horn of the same may not be tooted." The President of this Society must have anticipated the wisdom of this injunction when he asked me to be the horn soloist for the Society.

To our colleague, Mr Henry Gannett, is given the credit of having originated the flattering invitation, "Sit down five minutes and tell me all you know." If this idea was in the mind of our President when he asked me to tell all I knew of the activities of the National Geographic Society in ten minutes I hope he intends that I shall keep the change, for it will not need so much time to traverse in outline this topic, though its bounds be the points in which the ultimate east meets the ultimate west and the north has the south for its antipode.

That we exist is attested by a membership of more than 50,000, and the question as to why we exist must be answered favorably by the thousands who each year come into our ranks.

I was greatly impressed a few years ago by a set of drawings showing the way in which geography is taught in the public schools of Brussels. The first of the series showed the plan of the classroom, with the position of the pupil's desk. The second gave the floor-plan of the building with special indication to mark the room which was the entirety of the first lesson. As lesson followed lesson the pupil had located the building with respect to the prominent buildings of the city, the situation of the city with respect to the other cities of the kingdom, the outlines of the kingdom, the place of the same in the continent of Europe, Europe's place on the eastern hemisphere, and finally a map of the entire world.

In this way the pupil oriented himself with respect to his playmates and their immediate surroundings with respect to the great world of which they were parts. But in the lessening scale the pupil, though great in his own conceit, dwindled as lesson followed lesson and the world of which he formed a part grew vastly in importance.

The proper study of mankind is man—not man in his littleness, in his finiteness, but the house in which he lives, the town in which he dwells, the land he calls home, and the world over which he roams. Each day's walk takes him to a different point and every day's journey gives to him a new geographic position.

The air he breathes is wafted along by purifying currents whose movements we strive to know. The water that slakes his thirst follows courses whose meanderings we want to trace; the paths he treads, the roads he travels and the oceans on which he journeys must find places upon our charts.

The purpose of our Society is to know these things and to diffuse abroad our knowledge. We seek new facts through exploration and we scatter them over the civilized world on the pages of the best geographic magazine that finds a place on the reader's table.

Our affairs are directed by a board selected from every walk in life fitted to aid in our great endeavor. The ablest business men of our city guide its financial interests. By their side sit those who have explored the frozen regions of the north and others who have labored under

tropical suns. Astronomers who follow the orbits of celestial worlds, geologists who read the testimony of the rocks and tell us the story of the earth on which we dwell; physicists to measure the stress and strain of those great cosmic forces that shape our globe, and geodesists to compute its resultant form; botanists to trace the migrations of plant life and meteorologists to chart the winds that waft the seed; a physician to direct our studies of the relation of health to locality and a biologist who gives to each form of animal life its metes and bounds; a statistician who places in stately columns the figures that show economic development and achievements and a journalist lays for us a course through the world of letters. The world's greatest inventor gratifies our Athenian thirst for new things, and officers of the Army and of the Navy see to it that our facts are well marshaled and our conclusions prove invincible.

These men—busy men—gladly give their time to the great work of this Society, and, seeking no reward, find full compensation in the conviction that under their guidance the Society is living up to its avowed purpose to increase and diffuse geographic knowledge, and sister societies throughout the world gladden our ears by repeating the vesper anthem of the sixth day of creation when the Maker, in looking upon His work, said, "It is good."

THE TOASTMASTER

It might very fitly be said that the only reason that a man may have for the acquiring of more wealth than he needs for his own material wants is that he may give wisely and give well; that he may aid in the betterment of mankind, in the uplifting of civilization, in doing something to make the burdens of his fellows a little lighter, and to add more to the intellectual appreciation of those who study the great problems of the universe. There is no man in the world who has done more to help in that great work of uplifting mankind than that little giant, Andrew Carnegie. He does not expect to speak to you tonight, but I know that no matter where you place him, no matter from what altitude you drop him, he will always land upon his feet. Therefore I introduce to you now to give us a few words—and they are always words of inspiration when they come from him—Mr Carnegie.

MR ANDREW CARNEGIE

I have often been surprised in my short life, but never quite as much as at this moment. I promised to talk to the Associated Press in New York, now banqueting at the expense of the New York *Times,* and I had just spoken to the party there through the telephone. I met Commander Peary and he had just preceded me. He is not only a fellow Pennsylvanian, but he comes from the crest of the Alleghanies at Cresson, where I spent my summers when a young man. I had the pleasure of presenting to Commander Peary honorary membership of the Pennsylvania Society recently and did it in these words, and I was so glad that Master Shakespeake came to my relief: "Fellow Pennsylvanian, your hand in mine—'Yours is a triumph where honor travels in a path so narrow that but one goes abreast.'"

I listened to what you said about giving surplus wealth. Well, I said to the gentlemen and ladies I addressed last night at the Carnegie Institute here, as I pointed to the professors that were gathered from various stations, from the Pacific, from the Atlantic, and the work they had done—I pointed to the trustees who have one and all given years of their life to this work—"theirs is the credit, theirs the triumph. I only gave money—mere dross in itself—these men have given their lives, themselves, to the great work of obtaining knowledge and spreading it throughout the world, not for one country, but for all the world. No rivalry, all anxious to help each other in the obtainment of knowledge."

That is what makes human life sublime. I, who only give money, give the material body only. It is those workers who have infused into the dead, inert

matter the soul within, and these are the men who are entitled to the credit. And so it is with all the money I give.

When I gave Doctor Billings one morning seventy-eight libraries for New York—that was the biggest wholesale order I have ever filled—I was met with congratulations the next morning when walking down the street. "What do you congratulate me for?" I asked. "Why, for giving New York seventy-eight libraries," was the answer. "Cannot receive your congratulations, gentlemen," was my reply, "but if you will congratulate me upon the bargain I made with New York, by which she agreed to maintain seventy-eight branch libraries free to all the people, shake."

I thank you for inviting me here. I thank you gentlemen for your applause and ladies for your smiles. I am the happiest man in the world, because I know that it is not what I have done that I pride myself upon. It is rather upon what I have induced others to do. Ladies and gentlemen, let me assure you I make splendid bargains with all the money that I apparently give away for nothing.

THE TOASTMASTER

Mr Carnegie gives all the credit to those who are doing the work under his beneficence, but I would say to him that that good old Scotch brain of his never gave a dollar that he did not in his wonderful divination see far at the end some beneficent purpose, and I would say to him that a stream never rises higher, sir, than its source.

We have on our Board of Management, I am proud to say, a very wide diversity of talent, and I shall introduce now Admiral Chester, of the United States Navy, formerly Director of the Naval Observatory, who had charge of the party that went to Africa several years ago to view and to observe the eclipse, and who has done a great deal of highly creditable scientific work. We shall ask him to say a few words with regard to the work of Commander Peary in the polar regions during the past 20 years.

TWENTY YEARS' SERVICE IN THE ARCTIC—REAR ADMIRAL COLBY M. CHESTER, U. S. NAVY

My distinguished colleague has given an account of the objects of the National Geographic Society, and it is my privilege to present a brief statement of the work done by our doubly honored and highly esteemed member, Commander Peary, work that has resulted in such signal success as to probably make him the honorary member of nearly all geographic societies of the world.

Beginning back in 1886, Mr R. E. Peary, then a young civil engineer of the U. S. Navy, originated and put into operation an entirely new project for Arctic exploration, and with a Dane, Maigaard, reached a point near Disco, Greenland, some 50 miles from the sea. With the experience and whetted appetite for Arctic exploration gained on this trip, he soon organized a second voyage to the Polar Seas and landed at McCormick Bay, in August, 1891, and although his leg was broken in crossing Melville Bay, and he had nothing more than an Arctic winter and its attendant discomforts before him, he persisted in his determination to go north, and but few people can realize what he courageously must have passed through during that long Arctic night.

His primary object was to study the Esquimos with a view to utilizing them as a force with which to eventually reach the North Pole, and he took upon himself their habits and customs to better enable him to gain their confidence and command them when ready for the campaign quite on the same principle as our army has organized Porto Rican and Philippine Scouts to deal with military subjects which the natives of the country can best negotiate.

Early the following spring Peary, now able to travel, made a brilliant sledge journey of 1,300 miles, crossing the divide of 5,000 feet elevation between Whale Sound and Kane Sea, in Greenland, reaching the northern edge of the inland ice, near 82° north latitude, and discovering Independence Bay.

Again in 1894, after struggling and sacrificing his personal comfort and means to raise funds for his third expedition, we find Peary back in the frozen north with a slightly increased force, making a remarkable sledge journey of 134 miles in 13 days to an elevation of 5,500 feet.

Here he was met by violent gales and cold weather, and with his dogs dying and his men disabled, he sent his main party back to the coast, while with almost superhuman effort he plodded on another 85 miles to the good, only to be finally overcome by the elements and forced to return to his base of supplies.

In spite of the fact that he had insufficient food and fuel and that there was but little hope of replenishment, Peary would not return to the United States when the visiting steamer *Falcon* arrived in 1894 to take him back, and he spent the following winter in accumulating the resources of the region at Bowdoin Bay, living with Lee and his ever faithful Hensen as the Eskimos live, and gaining recruits for the next march to the north.

This began in April, 1895. With his two men and 63 dogs he had made but three marches when one of his Eskimos deserted with the outfit he had struggled so hard to accumulate; but Peary, undiscouraged, pushed on.

After a journey full of hardships such as had never been successfully overcome on any previous Arctic voyage, he again reached Independence Bay, whence he returned to Bowdoin Bay, with man and beast on the verge of starvation and everything but Peary's indomitable pluck entirely exhausted.

On board the little steamer *Kite* his party reached Newfoundland, September 21, 1895, and thus ended the third expedition.

General Greely speaks of this trip as follows: "If Peary's advance beyond his buried cache (on the highlands of Greenland) was one of the rashest of Arctic journeys, yet the courage, fertility of resource, and physical endurance displayed by him and his companions placed their efforts among the most notable in Arctic sledging."

Peary by this time had a thorough knowledge of the men with whom he was to finally reach the goal for which so many generations have struggled in vain. He had weeded out the dishonest ones, honored the good ones, and educated them all.

In June, 1898, Peary left New York on board the *Windward* for a four-years' expedition against the pole, this time carrying on explorations on the west shores of Baffin Bay, where he determined the continuity of Ellesmere and Grinnell Lands, and in December he was badly crippled and nearly lost his life, his feet being so badly frozen as to cause the loss of eight toes by amputation, yet he took the field again in a few weeks after the operation. In the spring he discovered Cannon Bay, and probably Heiberg Land. The winter of 1899-1900 was spent at Etah, from which place he made his first effort to reach the pole. After following the west coast of Greenland to the most northern point in about 83° 35′ north, he started north over the polar pack, but could only make good about 20 miles of ice travel before turning back in latitude 83° 54′ north. Though the North Pole was not reached, he made a valuable contribution to geography by the discovery that Greenland was an island.

In the following year, 1901, Peary again made the attempt to reach the pole by the Cape Hecla route, but was forced to abandon the attempt in April.

Still undismayed, Peary started again for the goal in February, 1902, proceeding from Payer Harbor to Fort Couger in twelve wonderful marches, and covering 400 miles in one month, with temperature ranging from—38°-57°. Leaving the land at Cape Hecla on April 6 with seven men and six dog sledges, he now surpassed all previous explorers and attained the highest latitude reached in the Western Hemisphere, 84° 17′ north latitude.

For the sixth time Commander Peary started on his quest for the pole in July, 1905, leaving New York in the *Roosevelt*, a powerful steamer with auxiliary sailing power, the first vessel to be built

in America for Arctic work, for which she was designed especially by the Commander. Fighting her way up through Kane Basin and Kennedy Channel by the Baffin Bay route, she reached Point Sheridan, on the north coast of Grant Land, where winter camp was made. Early the following spring he divided his force into four parties, each with its sledges and dogs, Eskimo drivers and hunters. This expedition is of such recent event that I need not remind you of it. Suffice it to say that now after having occupied points, "one on the most northerly point of Grant Land, and thus of the North American Archipelago; another on the most northerly point of Greenland, and the third on the northern point of Peary Land, the most northerly point in the world ever visited by man, he wins the pennant for highest north in latitude 87° 6′."

All this was a schooling for that "last great struggle to plant the American flag at the pole," the story concerning which the members of the National Geographic Society have been privileged to hear from our honored guest's own lips. Was there ever a campaign carried out after so much physical and mental effort as Peary's last? If, as Dr Lyman Abbott has said, its Commander has done nothing else, he has taught the youth of our country the lesson of hard work and perseverance to their everlasting benefit.

Remember the last and final effort of his life in this direction was based on an original design. As he says, "the Eskimos with their dogs are the factors that make the search for the pole feasible." He became one of the tribe—the leader of the tribe. They called him their father; he called them his children. A theme could be written on this one text, and yet how little it is understood except by those who have been Peary's companions.

Captain Bartlett told me that the Eskimos would follow the Commander as they would no other man under the sun; that they were afraid of the sea ice as a little child was of the sea water, but they would follow Peary anywhere; that there was not another living man that could get an Eskimo far away from the land; that even Peary had doubts on this subject at times, and he would say confidentially to his ever faithful assistant, Bartlett, "Are there any signs of desertions?" to which the latter would reply, with a strong voice but fearful heart, "Oh, no, don't think of it; they will follow you to the last," and so they did. I am satisfied that Bartlett was right—that while their love was tested to the extreme the Eskimos would follow Peary to the ends of the earth, but that they could be led by no other man more than "two sleeps" from land.

After returning from this last expedition I heard Peary say once, "I can never go again to the Arctic regions; I am getting too old," but his never-say-die grit overcame his yearning for the home life and rest he so much needed, and he is soon in training for the death struggle of his life. Acting under the laws of Congress, to the effect that as far as practicable all hydrographic work of the U. S. Coast and Geodetic Survey shall be done by naval officers, he was detailed by direction of President Roosevelt, the patron of all such efforts as Peary's, to that department to carry on hydrographic investigation in Arctic seas in association with the Peary Arctic Club of New York. And let me say here that the one sounding of 1,500 fathoms without reaching bottom made by Peary near the pole is worth to the country more than all the money expended in the entire expedition, but the great mass of scientific data accumulated in his 23 years of effort has enriched the land beyond the expenditure of any possible amount of money.

The last of Peary's campaigns was a masterpiece of strategy. His force was divided into four grand divisions, led by brilliant chiefs. We can hardly overestimate the value of this organization.

I would call your attention right here to the selection of Captain Bartlett for the command of his fourth division, the post of honor. Remember that this was the one man who alone was fully competent to take the *Roosevelt* from her ice

anchorage at the farthest north of any previous navigation back to civilization with all her priceless cargo of Arctic heroes. To take the second in command from this important post for a forlorn hope was beyond the borders of rashness—it was tempting Providence. Read the story of the *Polaris* expedition, and you will find that by all good rights Bartlett should never have left his ship.

But overcome by his regard for his faithful assistant, by the knowledge of Bartlett's great value to the land party, as well as by his desire to do honor to our kindred race, living under the cross of Saint George, he was given the post of honor—the advance, when it meant that had the expedition ended at latitude 87° 48′ north, the second in command would become the first in honor, for he first reached this parallel two hours ahead of the main party. As it is, Bartlett hangs on his escutcheon "The Highest North" up to that time, to give away only to his chief in the still higher claim of "no north, no south, no east, no west."

Even if Peary dared do so, he could not have given the charge of his highly honored returning party to any other man under his command and do justice to those faithful children of his who were entitled to his protection. As far as a witness to Peary reaching the pole is concerned, if he needed one, he had the best one living—Hensen—a faithful colored man whose truthfulness had been tested in twenty-three years of manly and intelligent effort with his chief. Besides this, he was a man fully competent to at least record observations, and it is believed he could have made them himself.

I have often been asked what is Commander Peary's real title in the navy, and some have questioned the propriety of my calling him Commander. While Commander Peary is not a commander in the navy, he belongs to one of the most important and highly respected corps of the service—the Corps of Civil Engineers—and really outranks, or soon will do so, every commander in the navy.

However this may be, if, after being in command of the Peary Arctic expeditions for nearly twenty-three years, displaying the highest degree of executive and administrative ability, he is not a commander, then I do not know what the term implies.

The North Polar Arctic Expedition of 1908-1909, led by Commander Peary, was not a "dash to the pole," as it is popularly termed by the public, but was a grand campaign laid out on truly military lines like one of Napoleon's brilliant inspirations, and as original in conception as any of that great soldier's. Peary first went through a long span of years in the study of Arctic conditions and in the preparation of the force he was to handle. This, when ready, was followed by an advance of his lines from the east, and resulted in the discovery of the insularity of Greenland, and that the route to the pole was not landward. He then retreated to reconnoiter and find a weak point in his adversary's defenses. After a while he tried to blaze another trail, but was driven back by the elements, those great forces of nature before which man is impotent. While his advance here was made from a base west of the position first attempted, it led him into fields where the ice was broken, and the leads—"those nightmares of Arctic explorers," as Peary calls them—left him no recourse but to retreat again.

The final assault on the North Pole, the best defended and long resisting stronghold of nature, was begun from a point still farther west, where the land jutted out into the Arctic Sea of ice much nearer the pole than any other land from which an advance was possible. From here was begun that "last of the world's great stories" which so simply and modestly, and yet so graphically, has been told by him.

The forces were led up by divisions with marvelous precision and discharged their weapons, the only ones possible to use in this campaign—provisions—and then fell back, leaving the Commander on the one hundred and thirtieth-mile line to begin the real "dash to the pole." From this point began the "Charge of

the Light Brigade" that ended successfully a campaign comparable with those of Alexander, Napoleon, or Grant. Long after all of us have passed away, Peary's name will be emblazoned on the scroll of fame as one of the great commanders of the world.

THE TOASTMASTER

It is certain that in all the history of our Arctic exploration there is one commanding figure that stands out preëminent. It is fitting that now at this time I should give a brief recount of what will not be celebrated here tonight, but what is essential as we are step by step leading up to the honor of this great American.

He was born in Cresson, Pa., in 1856; was graduated from Bowdoin College in 1877; entered the United States Navy as civil engineer in 1881; was assistant engineer in the Nicaraguan Ship Canal under Government orders in 1884–85; was engineer in charge of the Nicaraguan Canal survey in 1887–88; in 1886 made a reconnaisance of the Greenland icecap; was chief of the Arctic expedition sent by the Academy of Natural Science of Philadelphia in 1891–92 to the northeast angle of Greenland; discovered and named Melville and Heilprin Land lying beyond Greenland; received the Patron's gold medal of the Royal Geographical Society of London and the medal of the Royal Geographical Society of Edinburg for determining the insularity of Greenland; made a study of the little Arctic islanders; in 1894 discovered three meteorites, one of which, the largest known to exist, weighed ninety tons; in 1896–97 brought these meteorites from Cape York to the United States. Commanded the Arctic expeditions under the auspices of the Peary Arctic Club of New York in 1898 to 1906, on which expeditions he rounded the northern extremity of Greenland Archipelago, the last of the great land groups, naming the most northerly land in the world, which is situated at 83° 39′ north latitude, and attaining the highest north at 87° 6′, for which he was awarded the Kane gold medal by the Philadelphia Geographical Society, the Daly gold medal of the American Geographical Society of New York, and the Hubbard medal of the National Geographic Society.

In 1908, under the auspices of the Peary Arctic Club of New York, in the good ship *Roosevelt,* commanded by that indomitable commander, Captain Bartlett, he again sailed for the north. No expedition ever was more perfectly planned or efficiently manned and officered. Why, it was the result of twenty years of a master mind, and the North Pole was reached on April 6, 1909. This was accomplished not only by the expenditure of tremendous physical energy, but by the employment of a high degree of intellect in planning to conserve this energy and to expend it so as to gain the greatest possible efficiency. In no other way could the North Pole ever be attained over land and over ice and water. The time may come—I believe it will come within a decade—when we shall fly over these regions that have seen so much heroic endeavor by the hardy men of nations whose representatives are gathered with us tonight, and I am of the opinion that this is the last great struggle to accomplish the pole overland.

But now, Commander Robert E. Peary, in presenting to you the special medal of the National Geographic Society, in recognition of an achievement that has brought honor to the American people, I wish to add that in all of your twenty years of heroic endeavor there has never been a time when any man associated with you, or any other person, has ever doubted your manly integrity or questioned for one moment your veracity. The American people were willing to believe that you had attained the pole by your simple statement. But science is critical. It accepts no word. It renders no decision without the proof.

And again I compliment you on the fact that before you received honors from any other source you diligently sought to present your credentials and to have them received and certified to by a competent tribunal. Those records were submitted—records made in the Arctic, not

edited or prepared. I had the opportunity to meet with the committee and see the original data, and am satisfied that there was not an "i" dotted or a "t" crossed from the time the record was made, far away there in the cold fastnesses of the north. And so the decision was rendered in accordance with your claims.

And now, in presenting you with the medal of the National Geographic Society—which is voted to you by the representatives of more than fifty thousand people, thinking, active working people in the world, through its Board of Managers of twenty-four, representing nearly every type of scientific knowledge—I wish to say, sir, that in honoring you as the man we honor not only our Society, but—I speak for our guests—honor ourselves.

RESPONSE BY COMMANDER PEARY

President Moore, ladies and gentlemen of the National Geographic Society: I cannot tell you how deeply I appreciate the words of your President, how deeply I have appreciated the chivalrous, magnanimous speeches of those distinguished representatives of two great nations whose own men have done magnificent work in the Arctic regions, and who have kindly spoken here tonight; how much I have appreciated those clear, concise remarks of our greatest philanthropist; how much I have appreciated the friendly words of Admiral Chester.

Far deeper than words is my appreciation of this magnificent trophy, conveying the faith and approval of this great Geographical Society, and awarded in connection with the most extraordinary state of affairs that has ever happened in the entire history of exploration and discovery.

It is particularly appropriate that the greatest Geographical Society in the Western Hemisphere should be the first to officially recognize the winning of the last great geographical prize which the world had to offer, an accomplishment characterized by your distinguished committee as "the greatest which the Society can ever have opportunity to honor."

But mine is only a portion of the credit for which this trophy stands. Had it not been for the unswerving faith and backing (both moral and financial) of Morris K. Jesup, organizer and first President of the Peary Arctic Club; had it not been for the equally unswerving faith and backing of General Thomas H. Hubbard, the present President of the Club, and the members and friends of the Club who have furnished all the funds for the work; had it not been for the splendid loyalty, enthusiasm, energy, and endurance of the members of my party, from Captain Bartlett down, we should not have the North Pole here with us tonight.

As copartner with and representative and proxy for those whom I have mentioned, I accept your magnificent medal with feelings of the liveliest pride and gratification.

Permit me to convey to the Board of Managers of the Society, and through them to the Society itself, my own and my friends' acknowledgments for its instant perception and acceptance of the duties of its position, and its definite and courageous stand at a time when a stand for the truth meant becoming a target for the most virulent attacks from the ignorant, the vicious, and the deluded.

I wish also to convey the thanks of my friends and myself to that brother officer of superb personal and professional reputation, whose clear insight, constitutional hatred of a lie, and unanswerable arguments have done so much toward clearing the atmosphere, Admiral Chester.

Thinking men and officers accustomed to questions of personal and public duty and responsibility have understood matters from the first, and the public now appears to be grasping the fact that a navy officer does not often shirk a duty, and, when an officer of the United States Navy makes a deliberate statement concerning matters of which he has cognizance, that statement is, at all times and under all circumstances, to be taken absolutely at par.

The fundamental keynote of success in the last expedition of the Peary Arctic Club, which, on the 6th of April, 1909, discovered the North Pole, was *experience.*

If the pole could have been won by inexperience, or by a happy combination of fortuitous circumstances, it would have been won long ago.

Nor was it to be won by courage and endurance alone; if it were, England would have had the prize years ago, Norway would have had it in '95 when Nansen and Johansen cast themselves adrift into the unknown, and Italy would have attained it in 1900, when Abruzzi drove her colors to the front in spite of indescribable obstacles.

Accumulated experience, persistence, profiting by mistakes through a long series of years (the prime factors of success in any great work, whether it be the establishing of an enormous industry, the perfecting of a world-reaching invention, or the moulding of a nation)—these were the essentials which permitted the discovery of the pole by the last expedition of the Peary Arctic Club, and the essentials without which it cannot be reached again.

Let me call to your attention that the last expedition of the Peary Arctic Club had at its command the practical experience of twenty-three years of work in one field; that it had at its command a ship specially built for the work, after years of experience, tested in one voyage and then modified as the result of that test; that it had at its command a veteran personnel largely selected from the membership of a previous expedition; that it had at its command the pick and flower of the hardiest and most experienced men of an entire Eskimo tribe; that every item of its equipment was an evolution from years of experience and practical work in the same way that the last cup defender—and winner—was an evolution from preceding international yacht races, and that it had at its command the route to the pole that is recognized by all Arctic authorities as the shortest and best.

And then let me tell you that every atom of this specialized experience and equipment, every nerve of this veteran personnel, was not only utilized but *demanded* in the successful negotiation of the 413 miles of icy chaos, along the Cape Columbia route to the pole, *the route which is 100 miles shorter* EACH WAY *than any other route around the entire periphery* of the Polar Sea.

Here in this magnificent trophy of your great Society lies the final chapter of the last of the great geographical stories of the Western Hemisphere, beginning with the discovery of the new world, ending with the discovery of the North Pole.

Here is the cap and climax, the *finish,* the closing of the book on 400 years of history.

Here in this magnificent trophy of your great Society glitters the splendid frozen jewel of the north for which through centuries men of every nation have struggled and suffered and died—won at last and to be worn forever by the Stars and Stripes.

THE TOASTMASTER

The Board of Managers of the National Geographic Society have voted to Grove Karl Gilbert, a member of the National Academy of Sciences, and for many years an officer of the National Geographic Society, a Hubbard medal for his great achievements in geographic research during many years. Professor Gilbert is not here tonight, and his medal will be presented at a future time.

I shall introduce the Ambassador from Great Britain, one whom we all love so much and who has been with us before, to present to one of his own countrymen, Captain C. A. Bartlett, the medal for twice commanding the *Roosevelt,* and for being one of those heroic characters that have done so much to bring honor to our own nation and honor to that great nation of Great Britain.

THE AMBASSADOR FROM GREAT BRITAIN—HON. JAMES BRYCE

Mr Toastmaster, ladies and gentlemen: If it were not for the honorable duty that brings me to you tonight I should be very

much ashamed to appear before you at so late an hour as this. But I am comforted and encouraged by the reflection, as I introduce myself, that this is a thing which can never occur again. There will never be another occason in which a speaker will arise to present a medal to a man who has taken part in the discovery of the North Pole.

There is just one thought which in the midst of these festivities and congratulations weighs rather painfully upon me, ladies and gentlemen. For some centuries, as you have already been told, the discovery of the North Pole has been an object of curiosity, interest, and aspiration to all the civilized peoples of the world. They have thought about it, they have wondered when and how it would happen. A great German philosopher has observed that the pursuit of truth is even better than the possession of truth. Bold men were excited by the pursuit of the North Pole, and all the world was interested in following their deeds of daring. Now at last that pursuit has come to an end. The pole has been discovered. Commander Peary has found the pole. But the world has lost the pole. We have no longer this achievement to look forward to. The riddle has been solved, the curtain has been lifted, and was it fair to posterity to take away such an object of aspiration from it? I tremble to think, ladies and gentlemen, of what will happen when all the riddles of the earth have been solved and those countless generations that are to follow us have nothing that they do not know about this habitable globe of ours, a small globe, after all, too small for the restless and eager mind of man.

Now, having relieved my mind by this outburst of sadness, I come to the business which you have entrusted to my charge, and that is to present this medal to Captain Bartlett. It was a graceful and charming thought on your part, gentlemen of the National Geographic Society, that you should present this medal to Captain Bartlett, and I can assure you that it will be heartily appreciated in the good country to which Captain Bartlett belongs, and by those who, in other lands, on the shores of many seas, live under the British Crown. I thank you and the National Geographic Society for it. But you have already had an acknowledgment by cable from the President of the Royal Geographical Society—one who bears an honored name, for he is the son of the great Charles Darwin—of the pleasure which it has given to that oldest of the Geographical Societies of the world.

Now, Captain Bartlett belongs to an ancient and famous line of Arctic explorers who have sailed under the flag of England. That line begins with the ever to be honored name of Henry Hudson, who perished in the great bay that he discovered. And it is illumined by many an illustrious name thereafter, among whom perhaps the most famous is Sir Edward Parry, who made his wonderful advance toward the pole, far outstripping any who had gone before him; Sir John Franklin, Captains Ross and McClure, and McClintock, and many another of whom time would fail me to tell, dauntless spirits who bent their strength and their powers to the work of polar and Arctic exploration.

I remember seeing long, long ago, at meetings of the British Association and of the Royal Geographical Society in Britain, some of these ancient weather-beaten veterans of polar exploration, and I know how it would rejoice them now to think that that for which they labored had at last been achieved. And if you want to know that the gallantry which animated those men and which made them bear cold and hunger and ill-health, and face all the perils of snowy wastes and floating ice in the pursuit of discovery, if you want to know that that spirit lives still with undiminished force in men of British stock, you have only to read the lately published narrative of the gallant effort to reach the South Pole made by Lieutenant Shackleton and his comrades, which brought them within 97 miles of that remote and perious goal. This was done by the courage and hardihood of Lieutenant Shackleton.

Ladies and gentlemen, we are proud to think that the United States and Great Britain have been partners in this splendid work of Arctic exploration. The United States took up the work some forty years ago, and the names of Kane and Greely and others, above all of Commander Peary himself, show with what energy and spirit and courage and skill and perseverance you have pursued it.

But do not let us forget, in the pride which we feel in the achievements of the stock to which we both belong, what has been done by the other great nations of the world, to some of whose members reference has already been made, more particularly to the Duke of the Abruzzi, whose representative is present here tonight. Barentz must be remembered, and Weyprecht and Nordenskjöld. And there is another man whose wonderful feat of launching himself out upon the Arctic Sea and voyaging for many hundreds of miles upon ice floes is perhaps without parallel in history for its daring, and ought to be remembered in the presence of the Minister from Norway—I mean Dr Fridthjof Nansen.

Now, ladies and gentlemen, I have the great honor of being asked to present this medal of your Society to Captain Bartlett. You, Captain Bartlett, belong to a calling which has always been able to boast of a host of hardy and adventurous seamen. You have been, on your own grim, tempestuous coast of Newfoundland, accustomed to all the perils of storm and iceberg, and it is in the line of your calling to know how to deal not only with the dangers that icebergs threaten, but with all the other terrors that the northern seas contain. You belong to a family which has signalized itself even in your land by the number of gallant seamen it has produced. I may state that there are so many Bartletts who have made distinguished and successful voyages on the North Atlantic coasts that this one who we see here tonight is familiarly known by his Christian name. He stands out from the other Bartletts as Captain Bob. He has had ten years' experience sailing with Commander Peary as the captain of his ships in his various expeditions. And I want to tell you that in those years that Captain Bartlett was sailing there never was a man lost upon those ships in those expeditions.

Captain Bartlett, I have the honor to present to you this medal. Brave men are always generous, and Commander Peary with characteristic generosity has acknowledged how much he owes to you. Your name will go down along with his in connection with the discovery of the North Pole, and you have in this medal a trophy which you can pass on to those who come after you as a memorial of the honor, the well-earned honor, which the National Geographic Society has paid to you.

Ladies and gentlemen, I rejoice to think that Great Britain and the United States are associated on this occasion. And as we congratulate you, Captain Bartlett, so I venture on behalf of my country to congratulate you, Commander Peary, and you, citizens of the United States, upon this splendid achievement—an achievement which will stand alone to the end of time.

RESPONSE BY CAPTAIN BARTLETT

Mr President, ladies and gentlemen: I would ask you just to bear with me for about three minutes. I am afraid to trust myself in speaking, but I have a few words jotted down here that if you will not mind I will read off.

I have the medal that you have been kind enough to bestow upon me, and I thank you in my heart. To be thus decorated by so eminent a body as the National Geographic Society is an honor of which any man can justly feel proud. To say, however, that the notice which you have taken of me affords me pleasure of the most genuine sort would be to state only a part of the truth. I am more than pleased. I am deeply moved at your distinguished consideration. My happiness in receiving this honor at your hands is increased by the fact that I never expected it. It is as unexpected as it is pleasant. It may be also that my appreciation of this medal is enhanced by the

knowledge that its like can never be conferred again. It was struck off to memorialize a complete work, a work that is done, and well done. Commander Peary, with the pleasure that comes to me as I find myself in the midst of these honors, there comes the solid satisfaction of feeling that I have been of some assistance to a man of such sterling worth as Commander Peary (and I can look you straight in the eye, sir, and say that), a man whose heroic character and high aims make him quite worthy of the great fame that has come to him.

For the very great honor that you have shown me on account of my humble aid in the great work, I once again return my heartiest thanks.

THE TOASTMASTER

We have honored Commander Peary, but I am of the opinion that really the greatest honor that he has received tonight is when the captain of his ship said, "I can look you straight in the eye, sir, and say that. I mean it."

Now we shall have a word from General Thomas Hubbard, the President of the Peary Arctic Club, which has done so much for the accomplishment of the North Pole.

GENERAL THOMAS H. HUBBARD

Mr President, ladies and gentlemen: The extension of time granted by the President to the earlier speakers does not apply to me, and if it did I would not avail myself of it, seeing that Mr John Barrett is waiting to follow me, and I do not wish to cut off his time. But it would be ungracious on my part not to recognize the high honor paid by this Society to Commander Peary and Captain Bartlett, and it would be perhaps more ungracious to make a long speech in recognition of that honor and courtesy.

The Peary Arctic Club is a young institution. Commander Peary is a good deal older than the Peary Arctic Club. I do not mean to imply that he is older than each one of its individual members, but he is older than all of them put together in a corporate capacity. The Peary Arctic Club is eleven years old—an infant—and yet it has witnessed the departure and return of Commander Peary, first upon that long four years' absence in the north, when he came back and said he did not reach the pole; next, after the one year's absence, when he came back again and said he did not reach the pole. Either time he might have said that he reached it. There was nothing to contradict him. It would have been impossible to refute the statement. But each time he came back and said he did not do it. And now he has come back and has said that he did it, and your action, the action of this eminent Society, has approved his record.

The Peary Arctic Club has Commander Peary as its chief asset, and his honor is theirs. They have divided with him labor and danger. I know my hearers will say that in dividing labor the division has been unequal. He has done the labor and they have looked on, and I must admit that their attitude during his absence has been that of a passive trustee. During his presence his own activity has stimulated theirs. They were kept active before he went away this last time, and they have been made more or less active since his return.

I beg to assure you that their activity has not included any conspiracies, has not included any attempt to destroy life, or blow up vessels, or steal records. How far they have shared his dangers I can only say by repeating the conversation that I had with him when he sailed out of the East River July 6, 1907.

It was a frightfully hot day and thoughts of the pole were refreshing. As I shook hands with him he said, "Take care of yourself," to which I replied, "It is an injunction I should give you. You have got to take care of yourself." Then his answer was, "Oh, no. One who knows the conditions of life in the Arctic regions is safer than he is in New York."

Now Commander Peary has made life and work in the Arctic regions comparatively safe. No one can make it safe to travel hundreds of miles over an ocean not frozen, but covered with floes likely

at any time to be disrupted. But so far as the danger of starvation, the danger of loss of supplies, the dangers that have been fatal to former explorers—so far as these things are concerned, Commander Peary has made Arctic exploration safe.

Of the dangers to those who remained here I will not speak. All imagine what they are. They do not relate to Arctic exploration. They do not relate to ice, unless it is the ice trust, and they do not relate to water. In my opinion they relate chiefly to too abundant legislation. The other night I heard a statement from Professor McMillan, one of Commander Peary's companions, who said that the Eskimos were the happiest people in the world. Commander Peary says a trip up in the Arctic is safe as compared with the dangers of New York or of Washington. I think the reason for that happiness of the Eskimo and the comparative danger of those who live in the cities throughout the United States is that the Eskimos are not governed by any laws except the laws of nature, and we suffer from a trinitarian government—the trinity of the legislative, executive, and judiciary. How can a people be safe and happy when laws are passed at the rate of twelve thousand a year, and when one State legislature in recent years made in one session three hundred and seventy-eight new crimes? How is it possible for the public to escape being made criminals?

But I am traveling outside of the subject of Arctic exploration and will come back so far as to say that those who have shared with Commander Peary the labor and the danger are entitled to some of the rewards. What are the rewards? The reward of the Peary Arctic Club is the great unparalleled achievement of Commander Peary, Captain Bartlett, and their companions, and that is sufficient to satisfy the ambition of the Peary Arctic Club and friends of the Commander. The recognition that he has received is not yet complete. His return has been met with some disappointments, but he must remember, as we all may, that such is the fate of explorers. Christopher Columbus at one time was sent a prisoner and in chains from the land he had discovered to the land that he had so much honored. Commander Peary has not been put in chains. In centuries to come his achievement will be recognized, and in behalf of the Peary Arctic Club I thank the members of the National Geographic Society that they have not waited for the lapse of centuries before recognizing the acts and the achievement of Commander Peary.

THE TOASTMASTER

We approach the South Pole from South America, and in closing this meeting I shall ask Mr Barrett to pronounce the benediction.

MR JOHN BARRETT, DIRECTOR OF THE INTERNATIONAL BUREAU OF AMERICAN REPUBLICS

Mr President, ladies and gentlemen: In memory of the lateness of the hour I congratulate President Moore and the officers of this Society and Commander Peary upon the significance and success of this banquet. I have only one observation to make, and that is, let us remember with reference to the future that the North Pole is not the only pole; that there is also a South Pole; that there is a great southland as well as a northland, an Antarctic as well as an Arctic Circle. And may we all gather here, possibly in a year or two years, to present a medal to that hero who shall discover the South Pole, whether he carry the flag of the United States, of Great Britain, or Italy, or France, or of that country which may produce a hero who may emulate the example of Robert E. Peary.

The members and guests present were:

Commander R. A. Ackerman, U. S. N.
Mr A. Aaronsohn
Mr and Mrs C. H. Ackert
Dr S. J. Allen
Mr D. G. Ambler
Representative Daniel P. Anthony, Jr., of Kansas
Mr Henryk Arctowski
Mr C. C. Arosenene, the Minister of Panama
Mr J. A. Aspinwall
Mr and Mrs O. P. Austin
Senator Augustus Bacon, of Georgia

Mr Harwood Bacon
Mr Thos. S. Baker
Mr Chas. B. Bailey
Admiral and Mrs G. W. Baird
Mr and Mrs Samuel N. Barker
Mr John Barrett, Director International Bureau of American Republics
Mrs Kate Walker Barrett
Representative and Mrs Richard Bartholdt, of Missouri
Captain Robert Bartlett
Dr L. A. Bauer, Director Department of Terrestrial Magnetism, Carnegie Institution
Mr Geo. H. Beaman
Mr Edwin C. Beers
Dr Alexander Graham Bell
Miss Aileen Bell
Mr Chas. J. Bell, President American Security and Trust Co.
Mr Gardiner Bell
Mr and Mrs Ira Bennett
Mr and Mrs John G. Bennett
Representative and Mrs Wm. S. Bennet, of New York
Mr and Mrs C. K. Berryman
Mr Ambrose Bierce
Mrs Robert Biggs
Lieutenant F. C. Billard
General John C. Black, Chairman Civil Service Commission
Mr Victor S. Bloeke
Colonel and Mrs H. F. Blount
Mrs Bertha H. Bohm
Captain H. T. Boin
Mr and Mrs Scott C. Bone
Rear Admiral R. B. Bradford, U. S. Navy
Mr Chas. S. Bradley
Mr J. A. Breckons
Mr Stacy H. Briant
Mr Robert Brott
Miss Brooke
Mr and Mrs Wm. A. Browne
Prof. E. F. Brusie
Miss Mary Bryant
The Ambassador of Great Britain and Mrs Bryce
Mrs J. Annen Bryce
Miss Bryce
Mr S. S. Burkett
Senator and Mrs Burkett, of Nebraska
Representative Albert S. Burleson, of Texas
Mr and Mrs W. K. Butler
Mr and Mrs Chas. Henry Butler
Minister of Costa Rica and Madame Calvo
Speaker Joseph G. Cannon, of Illinois
Miss Cannon
Mrs Carmody
Mr and Mrs J. W. Carnahan
Mr Frank G. Carpenter
Mr Fred W. Carpenter, Secretary to the President
Representative and Mrs Champ Clark, of Missouri
Mr Lucien W. Chaney
Admiral and Mrs C. M. Chester, U. S. Navy
Miss C. J. Christiansen
Mrs King Church
Mr W. A. H. Church
Mr and Mrs Price C. Claflin
Miss Margaret Claflin
Mr C. T. Clagett
Mrs Wm. E. Clark
Mr and Mrs B. M. Clinedinst
Representative Wm. W. Cocks, of New York
Mr H. G. Cole
Mr and Mrs Wm. Knowles Cooper
Mr F. V. Coville
General Wm. R. Cox
Mr and Mrs Elijah S. Cowles
Mr H. McC. Crist
Colonel Knowles Croskey
Mr J. M. Culp
Miss Helen M. Cummings
Mr and Mrs J. Harry Cunningham
Senator and Mrs Chas. Curtis, of Kansas
Mr and Mrs Wm. E. Curtis
The Minister of Chili and Madame Cruz
Miss Ida M. Daly
Mr and Mrs Oscar K. Davis
General Geo. W. Davis
Miss Elsie A. Davis
Mr Walter I. Dawkins
Mr Chas. Ray Dean
Mr Emile Diebitsch
Mr Wm. W. Doll
Miss Bertha L. Doty
Mr D. Wallace Duncan
Mr Geo. M. Dunn
Mr and Mrs Albion M. Dyer
Miss Dyer
Mr John Joy Edson, President Washington Loan and Trust Co., and Mrs Edson
Mr and Mrs Fred'k B. Eichelberger
Mr W. A. F. Ekengren, Secretary Swedish Legation
Mr and Mrs J. F. Ellerson
Miss Elliott
Mr and Mrs Edward S. Ellis
Mr Fred A. Emery
Miss Emery
Colonel R. K. Evans, U. S. A.
Mr David Fairchild
Mr Romolo Fanciulli
Mr and Mrs Richard Lee Fearn
Captain and Mrs A. J. Fechleter
Mr and Mrs W. W. Finley
Mr and Mrs Guy Finney
Senator and Mrs Fletcher, of Florida
Miss Louise Fletcher
Miss Nellie Fletcher
Mr Loring Fletcher
Miss Myra B. Floyd
Representative and Mrs David J. Foster, of Vermont
Representative and Mrs Geo. E. Foss, of Illinois
Mr Geo. S. Fowler
Mr and Mrs H. B. Fulton
Mr and Mrs H. M. Fulton
Mr F. A. Furst
Senator and Mrs Robert J. Gamble, of South Dakota

Mr Henry Gannett, Vice-President National Geographic Society
Mr H. E. Gerhard
Mrs Gibson
Miss Laura D. Gill
Representative Fred'k H. Gillett, of Massachusetts
Miss Lucy D. Gillett
Mrs H. A. Gillis
Mrs H. P. Godwin
Mr J. F. B. Goldney
Mr Samuel Gompers, President American Federation of Labor
General and Mrs Green Clay Goodloe
Prof. and Mrs J. Howard Gore
Mr Horace S. Gould
Mr John Graham
Mr O. R. Graham, Jr.
Mr J. T. Granger
Mr Benj. S. Graves
Mr Gilbert H. Grosvenor, Editor NATIONAL GEOGRAPHIC MAGAZINE
Mr Edwin P. Grosvenor
The Minister of Norway and Madame Gude
Mr W. B. Hadley
Mr Henry J. Haight
Miss Adelaide Haffords
Colonel Thos. H. Handbury, U. S. A.
Mrs Geo. A. Hart
Representative G. N. Haugen, of Iowa
Representative William H. Heald, of Delaware
Mr G. F. Heilprin
Miss Heilprin
Mrs Helmbold
Mr J. B. Henderson, Jr.
Mr Calvin W. Hendrick
Hon. and Mrs Robert L. Henry
Mr Hilary A. Herbert, formerly Secretary of the Navy
Mrs Geo. G. Herring
Mr and Mrs Arthur Herschel
Mr and Mrs C. Heurich
Miss Hickey
Representative and Mrs Ebenezer J. Hill, of Connecticut
Mr Samuel M. Hitt
General and Mrs Charles W. Hobbs
Miss Hobbs
Admiral and Mrs R. C. Hollyday, U. S. N.
Mr and Mrs E. M. Hood
General Thomas Hubbard, President Peary Arctic Club
Mr A. J. Huntoon
Mr Geo. W. Hutchison
Mr Frederic B. Hyde
Admiral Richard Inch, U. S. N.
Mr Alfred Mitchell Innes
Mr H. R. Insley
Lieutenant Colonel and Mrs R. B. James
Mr Mahlon H. Janney
Mr Chas. G. Jarboe
Mr and Mrs Carl F. Jeansen
Mr William Jessop
Mr and Mrs C. A. Joerissen
Mr B. F. Johnson
Mr Maurice Joyce
Mr and Mrs George H. Judd
The Ambassador of France and Madame Jusserand
Mr and Mrs Gus Karger
Mr and Mrs Rudolph Kauffmann
Mr and Mrs H. W. Kennard
Mr Clarence P. King
Mr and Mrs Geo. A. King
Hon. Martin A. Knapp, President Interstate Commerce Commission, and Mrs Knapp
Representative and Mrs J. R. Knowland, of California
Mr and Mrs Geo. C. Knowles
Dr Geo. M. Kober
Mr and Mrs John Oliver La Gorce
Representative John Lamb, of Virginia
Mr James L. Lancaster
Miss Helen Landell
Mr and Mrs John B. Larner
Mr B. F. Leighton
Mr Wm. B. Levy
Mr and Mrs Thos. W. Lockwood, Jr.
Mr Homer N. Lockwood
Mr and Mrs Edward H. Loftus
Representative and Mrs H. C. Loudenslager, of New Jersey
Mr and Mrs Edw. Lowry
Mr Craig McDonald
Senator McEnery, of Louisiana
Mr W J McGee
Mr and Mrs Percy McKay
Mr and Mrs Chas. A. McKenney
Mr and Mrs F. D. McKenney
Dr R. E. B. McKenzie
Representative Wm. B. McKinley, of Illinois
Mr N. E. S. McLean
Dr Malcolm McLeon
Mr and Mrs John H. Magruder
Miss Natalie Magruder
Mrs I. T. Mann
Representative and Mrs James R. Mann, of Illinois
Mr W. Sinkler Manning
Mr E. R. Martin
Mr Crittendon Marriott
The Charge d'Affaires of Japan and Madame Matsui
Mr Wm. F. Mattingly
Miss Mattis
Mr and Mrs Wm. A. Mearns
Mr H. G. Meen
Senor Don Merino, Secretary Spanish Legation
Mr and Mrs R. F. Miller
Mr Russell Hastings Millward
Mrs S. Murray Mitchell
Mr and Mrs J. Walter Mitchell
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The Marquis of Villalobar, The Minister of Spain
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Mr Morris Whitridge
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Mr and Mrs S. A. Willis
Mr Nathaniel Wilson
Colonel and Mrs M. A. Winter
Rev. Dr and Mrs Charles Wood
Mrs Woods
Mr S. W. Woodward
Captain J. W. Wright, U. S. A.
Mrs Marie Robinson Wright
The Chinese Minister and Madame Wu
Representative and Mrs H. O. Young, of Michigan
Mr M. W. Zimmerman

THE COAL-FIELDS OF ALASKA*

With a Few Notes on the Mineral Wealth of the Territory

THERE are two known areas of high-grade coal—the Bering River field, in the Controller Bay region, and the Matanuska field, north of Cook Inlet. The Bering River field, lying about 25 miles from tidewater at Controller Bay (see map, page 24), embraces 26.4 square miles underlain by anthracite and 20.2 square miles underlain by bituminous coal. The coal-bearing rocks trend to the northeast into the unsurveyed high ranges, and it is quite possible that there may be an extension of the coal-fields in this direction.

Coal-beds varying from 6 to 20 feet in thickness are exposed in this region, with some local swellings, giving a much higher maximum thickness. In quality the coals vary from an anthracite, with 84 per cent of fixed carbon, to a semi-bituminous, with 74 per cent of fixed carbon, and include some varieties that will coke. There has been much prospecting of these coals, but in the absence of railways no mines have been developed, though a small output from one bed has been taken to the coast in barges.

The Matanuska coal-field lies about 25 miles from the tidewater at Knik Arm, a northerly embayment of Cook Inlet. As Cook Inlet is frozen during the winter, however, the distance to an open seaport must be measured to Resurrection Bay, on the east side of Kenai Peninsula, about 150 miles from the coal-field (see map, page 3).

The known commercially valuable coals of the Matanuska field vary in quality from a sub-bituminous to a semi-bituminous, with some anthracite, and are included in folded and faulted Tertiary (Eocene?) shales, sandstones, and conglomerates, aggregating 3,000 feet in thickness.

The coal-beds vary from 5 to 36 feet in thickness, and the total area known to be underlain by coal aggregates 46½ square miles. However, as much of the field is covered by gravels and none of it has been surveyed in detail, the coal-bearing area may be much larger. The total area of what may prove to be coal-bearing rocks is approximately 900 square miles. Up to the present time there has been no means of transporting this coal to market, so that no mining has been done, but many beds have been opened in prospecting.

The anthracite from Matanuska and Bering rivers has no equivalent on the Pacific Coast, and it compares favorably with the Pennsylvania anthracite. It ought to be put into the San Francisco and other Pacific Coast markets at a cost far below that of Eastern coal, in which case it should have no difficulty in entirely supplanting the latter.

The Bering River semi-anthracite and part of the semi-bituminous coal from Matanuska is also better than anything that is being mined in the West. These coals are the equivalent of the Pocahontas, New River, and Georges Creek coals of the East, and are eminently adapted for use on warships and for other purposes for which a high-grade, pure, "smokeless" steaming coal is required, and for these purposes will command a considerably higher price than any coal now being mined on the Pacific Coast, or, if offered at equal prices, should readily drive the latter from the market.

Part of these coals will produce an excellent quality of coke—better, in fact (except possibly in content of phosphorus, regarding which no data are available), than coke which can be pro-

* From reports of Alfred H. Brooks, Chief of Alaskan Division, U. S. Geological Survey.

duced from any of the Washington or Vancouver Island coals, and equal to the coke from Crow's Nest Pass. If an important smelter industry grows up in Alaska, as now seems possible, the Alaska coking coals should have the advantage, both of quality and of transportation.

Before they can be mined it will be necessary to build about 150 miles of railroad to reach the Matanuska coal, and from 25 to 100 miles (according to the harbor chosen) to reach the Bering River coal. It is believed that either of these projects is feasible, and that if favorable title can be obtained both fields will be producing on a large scale within a few years. Railroads are now under construction to both these fields.

Mining developments in the Bering River coal-fields of the Controller Bay region and in the Matanuska coal-field of the Cook Inlet region have been practically confined to surveys for patents, assessment work, and trail building. The most important features are connected with the problem of railway construction.

No patents for coal land have yet been granted.

The value of these high-grade fuels of Alaska probably exceeds that of the gold deposits, and the exploitation of these coal-fields is of the greatest importance to the entire western seaboard of the continent. These coals will furnish not only the high-grade steam coals needed for various industries, but also the coke for metallurgical enterprises. If the iron ores of the Territory prove valuable, the west coast may yet be supplied from this source with the raw materials for the manufacture of iron and steel. In any event, the copper smelters can be provided with coke of a high grade.

The coals from other known Alaska fields than these are so situated or are of such quality that they can find markets only where excessive rates on outside coals give them an advantage; that is, their markets must be local and probably small. These lignites and lower grade bituminous coals have a wide distribution in Alaska, and some of them will have great value to local industries.

GREAT QUANTITIES OF PEAT

Peat is very widely distributed in Alaska, having been found in nearly every part of the Territory. The climatic conditions, as well as those of plant life, in the central and northern parts of the Territory, seem especially favorable for the accumulation of peat. Everywhere the soil is clothed with a dense growth of moss and other small plants, and the frozen condition of the subsoil and the shortness of the summer season prevent decay.

There is no information at hand on which to base an estimate of the available supply of peat in Alaska. As it is found in every part of the Territory, however, and as the great tundras of the north, occupying at least a quarter of the Territory, appear to be nearly everywhere underlain by peat of greater or less thickness, the supply must be enormous, and may equal if not exceed that of the entire United States.

In the presence of more easily available fuel there has been no occasion to utilize any of the peat deposits, so that little is known of their horizontal extent or thickness. It is not uncommon, however, to see thicknesses of 15 to 30 feet in natural or artificial exposures. The surface layer of peat, which forms the upper layer of the tundra, may not exceed a few feet in thickness, but locally these accumulations are many times as thick.

COPPER AND PLACER MINING

Alaska contains a large variety of mineral deposits, and these, especially gold and coal, are widely distributed. The auriferous gravels are scattered over a very large area, but much of it is unprospected. There are some large auriferous lode mines in southeastern Alaska and promising lode prospects in other parts of the Territory.

Copper mining has been done in two widely separated coastal districts. Very promising deposits of copper ore occur

in two inland belts which are undeveloped because they are not yet accessible by rail, and copper prospects have been found elsewhere in the Territory.

Tin, marble, gypsum, and petroleum have been produced from Alaskan deposits; iron and other minerals probably have future commercial value.

Mining began about 1880 and progressed slowly for nearly two decades, since which advancement has been very rapid. Much of the Pacific seaboard, with its cheap transportation, strong relief, abundant water-power and timber, and equable climate, is most favorable to low costs of mining. These conditions have resulted in the development of one of the largest low-grade gold-mining enterprises in the world, as well as some others of considerable magnitude. They have also favored the successful exploitation of comparatively low-grade copper ores, even at the low market value of the metal during the past year.

Though placer mining has been carried on in Alaska for nearly thirty years, it has been chiefly by the crude methods of the pioneer that more than $100,000,000 worth of gold has been won from the auriferous gravels. The modern epoch of placer mining, with labor-saving machinery, has only just begun, and the field in which such methods are used is capable of much expansion. Though the future discovery of bonanzas, such as have made Alaska famous in the past, cannot be predicted, it is certain that the possibilities of new finds are far from being exhausted, and that there are hundreds of creeks known to be auriferous which may yield gold in commercial quantities when means are found to reduce the present cost of operation.

The inland copper districts await the railway transportation, which will not only lead to the development of known deposits, but also stimulate further search for ore bodies. Such developments of a lode-mining industry will give a larger permanent population—at present Alaska's greatest need.

A full development of the mining industry of Alaska is possible only by the improvement of the transportation facilities. At least one railway must be built to the Yukon gold-fields, and the inland copper-lode districts and coal-fields must be connected with Pacific ports that are open throughout the year. Then, and not until then, can Alaska's mining industry be developed to the extent warranted by her known mineral wealth.

IMMENSE MINERAL OUTPUT

The total value of the mineral production of the Territory since productive mining began, in 1880, exceeds $147,000,000. In the following table the production by years and by substances is presented. This table is based on the best available information, but accurate statistics of the annual mineral output have been collected only since 1905:

Value of Total Mineral Production of Alaska, 1880–1908

BY YEARS

1880–1890	$4,686,714
1891	916,920
1892	1,096,000
1893	1,048,570
1894	1,305,257
1895	2,386,722
1896	2,980,087
1897	2,538,241
1898	2,585,575
1899	5,703,076
1900	8,238,294
1901	7,007,398
1902	8,400,693
1903	8,941,614
1904	9,567,535
1905	16,478,142
1906	23,375,008
1907	20,887,055
1908	19,929,800
	$147,972,701

BY SUBSTANCES

Gold	$142,030,637
Silver (commercial value)	1,120,562
Copper	4,265,136
Tin	92,640
Coal	315,079
Marble and gypsum	148,647
	$147,972,701

The known mineral wealth of inland Alaska is embraced in the two copper-bearing belts of Copper River, lying 100

to 300 miles from tidewater; the Bering River coal-field, 25 miles from the coast at Controller Bay and 100 miles from a good harbor on Prince William Sound; the Matanuska coal-field, 150 miles from an ice-free port on the Pacific, and the Yukon placers, from 400 to 600 miles by feasible railway routes from the Pacific. This inland region is separated from the Pacific tidewater by high, snow-covered ranges, broken, however, by several river valleys.

The full development of the mineral wealth of inland Alaska must await improvements in means of communication, which will need to be of a very radical character. The expensive and uncertain mode of reaching the Yukon placer districts by ocean and river boats or long winter sled journeys places so heavy a tax on the gold-mining industry as to make it in most places impossible to exploit anything but the richest placers. The copper deposits of Copper River and the coal-fields of Controller Bay and the Matanuska basin must remain unproductive until a transportation system has been developed.

Thanks to the Alaska road commission, and in a lesser degree to local enterprise, much has been accomplished in the way of road and trail building. Much, however, remains to be done, for in this Territory, embracing nearly 600,000 square miles, there are only 452 miles of wagon road, 397 of sled road, and 255 of trail. The coastal service of ocean vessels and the river transportation systems of the Yukon and its tributaries are being much improved. In addition to this, steamboats have been placed on Copper and Sushitna rivers. Local transportation facilities have also been greatly bettered by short lines of railway, such as those at the White Pass, at Fairbanks, in Seward Peninsula, and the Copper River Railway, which now extends from Cordova for about 70 miles inland.

All these improvements in means of communication, together with the military telegraph lines, wireless stations, and long-distance telephone systems, have

COMMANDER JENSEN OBSERVATOR PECHÜLE

Two members of the committee appointed by the University of Copenhagen to pass on Cook's claims of having reached the North Pole

done much to advance the mining industry. They can, however, be regarded only as supplementary to a system of railways, which alone can make available the mineral wealth of extensive areas. In fact, they serve to emphasize the inadequacy of the existing transportation systems. The industrial demands for better communication can be met only by railways which shall connect the mineral deposits with open ports on the Pacific seaboard.

PROFESSOR STRÔMGREN COMMANDER HOLM
OBSERVATOR ENGSTRÔM CAPTAIN RYDER

The other four members of the committee appointed by the University of Copenhagen, which examined the papers of F. A. Cook, and unanimously reported that Dr Cook had no proof that he had reached the North Pole.

ACKNOWLEDGMENTS

THE National Geographic Society has much pleasure in expressing its thanks and appreciation to the following companies and individuals for material assistance rendered to its Alaskan Expedition of 1909:

Borden's Condensed Milk Company, 108 Hudson St., New York, N. Y.—Condensed and evaporated milk.

Northern Steamship Co. *Lindsay*, Seattle, Wash.—Half rates, Cordova to Seattle.

Bausch & Lomb Optical Co., Rochester, N. Y.—Loan of 2 pair field glasses, 2 lenses for large camera.

Winchester Repeating Arms Co., New Haven, Conn.—Fifty per cent discount on shotgun, carbine, and ammunition.

Armour & Co., Chicago, Ill.—Extract of beef.

Keuffel & Esser, New York, N. Y.—Double mounted paper for plane table work.

Franco-American Food Co., Franklin St. and Central Ave., Jersey City, N. J.—Soups.

Eastman Kodak Co., Rochester, N. Y.—Discount on photographic equipment.

Williams Bros. Co., Detroit, Mich.—Canned goods, preserves, and pickles.

Schwabacher Grocery Co., Seattle, Wash.—Discount on groceries.

Merrill-Soule Co., Syracuse, N. Y.—Trumilk and truegg.

Katalla Company and Copper River and Northwestern Ry. Co., Cordova, Alaska.—Transportation, subsistence, maps, etc., for R. S. Tarr and Lawrence Martin.

W. and L. E. Gurley, Troy, N. Y.—Discount on topographic equipment.

Alaskan Division U. S. Geological Survey.—Maps and information, loan of instruments and assigning topographer.

U. S. Coast and Geodetic Survey.—Loan of instruments.

U. S. Bureau of Fisheries, Washington, D. C.—Loan of small sounding reel.

Jack Dalton, Cordova, Alaska.—Loan of boat, etc.

THE NATIONAL GEOGRAPHIC SOCIETY

THE Annual Meeting of the National Geographic Society occurred Friday evening, January 14. Reports of the Secretary and Treasurer were submitted and are printed below. The eight members of the Board of Managers whose terms expired at the meeting were unanimously re-elected for the ensuing three years, namely, Henry F. Blount, C. M. Chester, F. V. Coville, John E. Pillsbury, Rudolph Kauffmann, T. L. Macdonald, Willis L. Moore, and S. N. D. North.

At a regular meeting of the Board of Managers, January 19, Mr Henry Gannett, who has been Vice-President of the Society for the past five years and Chairman of its Committee on Research, was unanimously elected President; Mr O. H. Tittmann, Superintendent of the United States Coast and Geodetic Survey, was elected Vice-President, and Messrs O. P. Austin and John Joy Edson re-elected Secretary and Treasurer respectively.

REPORT OF SECRETARY O. P. AUSTIN FOR THE YEAR 1909

The year 1909 shows a large increase in the membership of the National Geographic Society and a general improvement in its condition and work. The number of members at the beginning of the year was 38,696, the number added upon their own application during the year was 18,152, and the losses by death and resignation 3,515, making the net increase during the year 14,637, and the total membership on December 31, 1909, 53,333, of which number 348 are life members.

This large increase in membership and consequent increase in the receipts of the Society has enabled it to give its members a larger and better Magazine, a material increase in the number of popular lectures, and to also set aside a considerable sum as a permanent investment.

The membership is distributed through all the States and Territories of the Union, and includes about 2,363 in the District of Columbia and between 600 and 700 in the Philippines, Hawaii, and Alaska. The membership in foreign countries is over 2,383 and represents fifty different countries and colonies of the world, including all the European countries, Egypt, India, China, Japan, Korea, Australia, New Zealand, the various South American countries, and several of the West Indian islands. The membership in Canada is 655; in Mexico, 391; in the Hawaiian Islands, 266; in

the Philippines, 203; in Alaska, 204; in Porto Rico, 59; in Cuba, 109; in Panama, 96; in Europe, 365, and in Central and South America, 118.

The Annual Dinner of the Society was held at the New Willard Hotel on December 15, and was largely attended.

It is with much regret that the Secretary records the death of Mrs Gardiner Greene Hubbard, October 20, 1909. The handsome building which she and her family presented to the Society and her constant interest in and assistance of the work of the Society from its organization, in 1888, have been keenly appreciated by every member of the Society. The following resolution was adopted by the Board of Managers on behalf of the Society, October 23, and sent to the family of Mrs Hubbard as an expression of the sympathy of the Society in their mutual affliction:

"The death of Mrs Gardiner Greene Hubbard is to the National Geographic Society a great, an irreparable loss, and to each member of the Board of Managers comes as a personal bereavement. Her broad and constant interest in the work of the Society, apparent during the decade in which her husband, Gardiner Greene Hubbard, served as its President, has, since his death on December 11, 1897, been its greatest stimulus to renewed activity in the work to which he devoted so many years and for the conduct of which he, twenty-one years ago, became the Society's first President. Her personal interest in its work in behalf of scientific geography and the diffusion of geographic information among the people, her attendance upon its meetings during the long years of its activities, and her individual recognition of the work performed by others in its behalf have been an inspiration to the officers of this Society, the members of the Board of Managers, the speaker upon the platform, and the Editor at his desk; while her splendid gift of a building which became at once a home for the Society and a memorial to its founder and first President now becomes of added interest as a memorial of her own generosity and a practical aid in the diffusion of information to all parts of the country and to all quarters of the world."

O. P. AUSTIN,
Secretary.

Report of the Treasurer, John Joy Edson, for the Year 1909

RECEIPTS

Cash balance as shown by statement of December 31, 1908		$24,533.82
Dues from members		89,782.02
Life members		2,700.00
Magazine, subscription and sales		9,088.01
Lectures, tickets		5,222.50
Advertising in Magazine		10,233.58
Interest on investments	$812.50	
Interest on deposit in bank	598.13	
		1,410.63
Publications		8,620.69
Grant Squires Medal Fund Endowment		500.00
Sundry		1,848.27
		$153,939.52

DISBURSEMENTS

Salaries, clerical hire, and services		$18,371.39
Magazine, paper, printing, etc.		52,451.27
Pound rate postage on Magazine		3,200.00
Postage		6,575.00
Printing and stationery		8,608.79
Lectures		5,089.69
Hubbard Memorial Hall, lights, heat, furniture, etc.		1,316.65
Publications:		
Printing, binding, etc.	$10,246.36	
Postage and expressage	913.02	
		11,159.38
Research Committee, Alaskan Expedition	$5,496.39	
Research Expedition to Naples and Sicily	250.00	
		5,746.39
Investments:		
Purchase of lot on 16th St.	$11,338.95	
Notes, secured by real estate	15,000.00	
Accrued interest on same	300.00	
		26,638.95
Advertising, commissions		716.18
Sundry		3,451.28
Cash, on deposit in the Washington Loan & Trust Company		10,614.55
		$153,939.52

ASSETS, DECEMBER 31, 1909

Notes secured by first deed of trust on real estate	$30,500.00
Publications on hand, at cost	7,000.00
Real estate, adjoining 28½ feet on 16th St. (purchase price)	11,338.95
Cash, on deposit in the Washington Loan & Trust Company	10,614.55
	$59,453.50
Liabilities, December 31, 1909	none

Respectfully submitted,

JOHN JOY EDSON,
Treasurer.

THE NEW YORK AQUARIUM

THE New York Aquarium had a greater number of visitors during the year 1909 than ever before, the attendance being 3,803,501—an average of 10,417 a day.

These figures show that the Aquarium has a greater patronage by the public than all the other museums of the city, including the Zoological Park, combined, and 1,800,000 more, for the same period, than the New York Hippodrome, which has probably the largest attendance of any theater in the city. These figures are unequaled by those of any other museum in the world of which statistics are available.

C. H. TOWNSEND,
Director.

Photo from Rev. B. St. John

A CAKE STAND: PEKING, NORTH CHINA

The carved tube is a piece of bamboo into which the cash is thrown as purchases are made

VOL. XXI, NO. 2 WASHINGTON FEBRUARY, 1910

THE NATIONAL GEOGRAPHIC MAGAZINE

A TRAVELER'S NOTES ON JAVA

BY HENRY G. BRYANT

THE island of Java, in the Dutch East Indies, by reason of the rich beauty of its tropical scenery, its picturesque native races, its varied history, and world-famous archeological remains, deserves attention from the intelligent traveler as a region worthy of special investigation. The writer, recalling how vague his own ideas were concerning Java before his visit to the island, and believing that few have had occasion to acquire special information relating to it, submits these random notes of a journey recently made to that fascinating region.

At the risk of trying the reader's patience somewhat, a few general facts relating to Java are submitted by way of introduction to the general narrative of the journey.

This favored isle lies wholly within nine degrees of the equator and equals in area the State of New York. Its surface is diversified by many lofty mountains, and it is remarkable for the great number of volcanic peaks which rise from the lowlands of the interior. No less than forty-five volcanoes are found on the island, and these range from 2,000 to over 11,000 feet in height, and many of them are constantly in a state of semi-activity. Within historic times several districts have been devastated by these explosive forces, while many will recall the eruption of Krakatoa, in the Strait of Sunda, in 1883, as one of the most desolating disasters of modern times. One result of this ceaseless activity of the forces of vulcanism during past ages has had the effect of covering the greater portion of the island with a thick layer of volcanic material which has produced a soil unequaled in the world for fertility.

This deep, rich soil supports a vegetation which, in luxuriance and variety, is unsurpassed by that of any other region of similar area, and ever since the Dutch established their first settlement on the island, in 1595, a golden harvest of agricultural products has been yearly garnered to swell the granaries of the colonists and the revenues of the home government.

To the visiting American perhaps one of the most noticeable features about Java is the distinctly paternal character of the Dutch colonial administration. This was impressed on us on our first landing at Batavia, where we had to report directly to the chief of police to obtain permits to travel on the island. Before these were granted, full answers had to be given as to our names, nation-

ality, occupation, age, and purpose in visiting Java. During our subsequent wanderings we were obliged to hold these permits in readiness for inspection by officials, and at all times we felt that our movements were a matter of some interest to the authorities. We are not surprised, therefore, to learn that the uniform policy of the government has been, in former years, to discourage foreign travel in Netherlands-India, and the present regulations are only a concession to the modern spirit which demands free intercourse among the nations.

NEARLY ALL LAND OWNED BY DUTCH GOVERNMENT

To one who hails from a country where private initiative counts for so much, it is something of a shock to learn that nearly all the land is owned by the government. In securing from the native princes by treaty and purchase the lordship of the land, the Dutch government also inherited the right to receive one-fifth of the produce and the labor of the peasant. This led to the introduction, in the year 1832, of what is known as the "culture system." This was a device to increase the revenues, and consisted in the exaction of forced labor from the peasants, who were compelled, under official supervision, to cultivate tobacco, coffee, sugar, tea, and indigo for their masters. This system of forced labor has been greatly modified in recent years, and I was informed that it now survives only in connection with the government coffee plantations. To most of us, doubtless, the one agricultural product of Java which is best known is coffee. It was something in the way of a disillusion to learn, therefore, that the famous "Government Java" of bygone days is of much less importance as a product of the colony than formerly. A destructive "blight" visited many of the plantations some years since. Some districts have not yet recovered from this, and in the meantime the coffee planters of Brazil have captured the bulk of the world's coffee trade.

While the richest of the Dutch East Indies, Java is also the most densely populated; the number of inhabitants amounts to as many as nine hundred per square mile in some districts. Aside from the sprinkling of Europeans and Chinese, the native population numbers 29,000,000. These all belong to the Malay race and almost without exception profess the religion of Islam.

The early culture of Java can be traced to India, and there is no doubt that this Hindoo influence had the greatest effect on the religion, language, and literature of the island. At the present time this influence is evidenced not only in the language and arts of the country, but by the great temples erected to Buddha. One of these, known as "Great Buddha," or "Boro Boedoer," is by many considered to be the greatest monument of Buddhistic architecture in existence. The Arab Mohammedan invasion occurred in the latter part of the fifteenth century, and when the Dutch began to extend their settlements, in the early decades of the seventeenth century, they found the faith of Islam extended to most parts of the island.

For the purposes of government, the island is divided into 22 residencies under the control of a Governor General, who lives in Buitenzorg. Each province has its Resident, who is assisted by various subordinates. In their dealings with the natives the Dutch find it expedient to collect the taxes and administer the government through an army of native officials. Thus native princes fill the office of regent in some of the provinces and "play" at ruling, but all real power rests with the foreign rulers, who are called "elder brothers."

Lying so close to the equator, the climate is a trying one to Europeans, although the style of dress in use and the manner of life do much to mitigate it. The rainy season lasts from October to April, and at all times showers may be expected. Residents urged upon us the importance of avoiding the direct rays of the sun during the heat of the day. One soon learns that Java is a country of early rising. The ordinary business

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ONE OF THE 988 BAS-RELIEFS OF THE TEMPLE AT BORO BOEDOER (SEE PAGE 104)

man has finished his coffee and is at his shop or office by 6 a. m. Between 9 and 4 o'clock all Europeans endeavor to keep indoors. The midday meal is taken between 1 and 2, and fashionable society does not bestir itself until after 5 o'clock, when driving and visiting is in order until 8 or 9 o'clock, when dinner is served.

Our sail of less than 48 hours over a tropical sea from Singapore to Batavia, the capital city of Java, is full of interest and mystery. Many of the passengers were expecting to cross the equator for

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ON THE WAY TO THE PAPANDAJAN VOLCANO

CUTTING RICE (SEE PAGE 107)

the first time on this voyage, and the captain promised to blow the whistle at the moment our vessel was supposed to cross the imaginary line. After dinner that first evening at sea, we hurried on deck to witness a sunset of rare beauty. As the clouds lifted, we beheld the great orb drop into the sea in a blaze of color whose tints changed even as we gazed on them. We had learned that a partial eclipse of the moon was to occur during the evening, and, to escape the heat below, as well as to see this phenomenon, all hands remained on deck. Presently the mysterious shadow darkened the face of "the bright regent of the sky," and, later on (at 8:15), just as the shadow reached its greatest extent, the ship's whistle sounded on the still air. A strange mingling of sensations, truly, when we gazed on one of nature's marvelous spectacles and at the same time realized that we were entering a new hemisphere, wherein the bright constellation of the Southern Cross beckoned us on to explore new lands and strange peoples.

All next day we sailed southwest, with the great island of Sumatra in plain view to the westward, and, late in the afternoon, entered Banka Strait, keeping on our port quarter Banka Island, so famous for its tin mines.

BATAVIA, THE CAPITAL OF JAVA

Early next morning we docked at Tandjong Priok, the port of Batavia. A swarm of native runners and porters boarded the steamer, directly the gangplank was in place, and such a jabbering and shouting I have not heard since the old days at Atlantic City, before silence was enjoined on the hack drivers.

Our present purpose in visiting Batavia was merely to secure permits to travel, and presently to trans-ship in another steamer to the eastern end of the island. After a short ride in the railway we arrived at Batavia, where we drove at once to the police headquarters for the permits.

The preliminaries attending the securing of permits to travel proceeded with true Dutch deliberation. After answering all the categories of the official, it transpired that the printed forms used for such purposes were all exhausted; hence it became necessary for the clerk to write out by hand the entire document. In due time the necessary credential was obtained, and we then undertook a drive about the city. The ancient city of Batavia proper is a grim, time-worn place, with many warehouses and government buildings grouped amid the intersecting canals. It is said to be unhealthy, and is wholly given over to commercial interests. Delaying here only for a brief survey, we continued our drive on clean, well-kept roads for two miles along canals suggesting Holland to the modern residential suburb of Weltevreden.

Passing under a white arch, we paused a moment to examine the two statues of fierce-looking native gods which guarded the portal, observing also a guard of Javanese soldiers who are being drilled by a native officer. Continuing our drive, we soon arrive at a broad avenue facing the Konigsplein, a great green parade ground, with its bordering streets shaded by rows of tamarind trees. Facing this extensive park are numerous neat villas built in the bungalow style, often embowered in cool foliage, the homes of active and retired officials, army officers, planters, and business and professional men who go to make up the white population of the capital. We soon come to an imposing building of classical design, which proves to be the Museum of the Batavian Society of Arts and Sciences. The copper elephant on a pedestal in front of the building was a gift from the King of Siam, presented on the occasion of his visit some years ago. This museum contains the finest ethnological collection of any institution in the Far East, and its publications rank well among the learned societies of Europe and America.

But the rising sun warns us of the approach of noon and we turn down a side street and soon reach the welcome coolness of the Hotel der Nederlanden. As a rule the hotels were found to be

A SUNDANESE GIRL

BEATING RICE FROM THE EAR

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A DUTCH GENTLEMAN AND HIS NATIVE WIFE AND DAUGHTERS

PEDDLERS OF SARONGS, THE NATIVE GARMENT (SEE PAGE 101)

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JAVANESE GENTLEMEN, SHOWING CONTRASTS OF DRESS (SEE PAGE 101)

clean, well kept, and admirably designed to meet the requirements of a tropical climate. They usually consist of a main building openly constructed, so as to admit the passing breeze, with wings containing the sleeping-rooms. The charges in Java are much cheaper than in other parts of the East.

THE RICE-TABLE

Here I made acquaintance with that famous gastronomic institution of Java

known as the Rijst-tafel or rice-table. Seated in a spacious pavilion, an army of beturbaned Malays brought us soup. Then large, deep plates were placed before us in which a supply of rice was deposited. On top of this basic stratum two inches deep we were expected to place an extraordinary variety of vegetables, curries, dried fish, eggs, fowls, and meats flavored with a variety of peppery condiments. After depositing on my plate eight of the dishes offered, limitations of appetite and space demanded a halt, and the remaining half of the sixteen varieties were allowed to pass untouched. Subsequent experience with this rice-table—so fearfully and wonderfully made—taught me discretion; but I shall never forget the bewildering dismay of that first encounter. In this connection, a recent writer remarks that "it is humanly impossible to partake of the rice-table and not to grossly overeat one's self." Perhaps in this daily over-indulgence in the pleasures of the tables we may find the explanation of the fact that the great majority of resident Hollanders are inclined to corpulence.

In the cool of the afternoon we returned to Tandjong Priok and boarded a vessel of the Royal Packet Company's fleet, which sailed the same evening for Soerabaya. A sail of 36 hours brought us to this city, the most important seaport in Java, with a good harbor at the mouth of the Solo River. We anchored off shore and soon after, embarking in one of the native boats, made our way amid the crowded shipping to the landing stage and passed the customs without delay.

Although commercially of great importance, Soerabaya is hot and presents few attractions to the visitor. We observed an air of bustling activity in the streets which seemed to verify the city's reputation for alertness and ascendency in the mechanical arts.

Turning our backs on Soerabaya, a two hours' ride on the railway, through a densely tropical region, brought us to Pasourouan, where we entered the curious carts of the country, called *dos-à-dos*, bound for the delightful mountain resort of Tosari. Ever ascending, we advanced past miles of rice and sugar fields to a pretty little hotel on the lower slopes of the mountain range, where we lunched. The remainder of the climb to Tosari was too steep for vehicles, so horses and palanquins were used for the final stage of the journey. The entire excursion was full of interest, taking us through different climatic zones, each exhibiting their characteristic growths in wild profusion. While two of us were advancing ahead of the main party we surprised a large black ape, which was walking in the road. He viewed us with interest for a moment and then disappeared into the forest.

With a feeling of intense satisfaction we arrived at this delightful sanitarium, where a sojourn of several days in the salubrious air of the mountains gave us renewed strength for our travels in the lowlands.

A walk along the single street of the village gave us some idea of the mode of life of these mountaineers, who are quite distinct from their neighbors of the lower valleys. Here are found the homes of the Tenggerese, that hardy tribe who, at the time of the Moslem invasion, retreated to these mountain strongholds and successfully defended their homes against the invaders.

The lofty location of Tosari, perched on a flank of the Tengger *massif* at an elevation of 5,480 feet above sea-level, invites one, by its invigorating air, to undertake walking trips and mountaineering excursions, which in other parts of the island would be out of the question.

Two of these jaunts which abide in memory as among the choicest of Javanese experiences were the trips to the crater of the active Bromo volcano and another early morning climb to the summit of Penandjaän, a loftier eminence which commands an extensive view of the eastern part of the island.

IN THE HEART OF OLD JAVA

With pleasant memories of our mountain sojourn, we discard our heavier

BOY MUSICIANS WITH BAMBOO INSTRUMENTS

Photo by H. G. Bryant

clothing and descend to the plains, and, delaying only one night in Soerabaya, take the government railway and in five hours arrive at Soerakarta, or Solo. This is the seat of one of the two great native princes, called the Soesoehoenan, who receives a handsome annuity from the government and is allowed to pose as ruler over four or five hundred thousand people. Here we are in the heart of old Java, where it is possible to see the native life of the people as it existed centuries ago. Owing to the good offices of the Resident, we were allowed to inspect the Kraton, the great wall-encircled compound of the reigning prince. Accompanied by a Dutch official, the morning after our arrival we drove to the palace. This is built in the center of an area surrounded by walls four miles in extent. An army of over ten thousand servants and pensioners live within the Kraton. At the entrance to the inner palace we were met by the brother of the Soesoehoenan, an agreeable gentleman, dressed in a jacket of European cut, but wearing the universal sarong about his lower limbs. The sash which held this in place contained a jeweled kris or dagger, the weapon which is worn by all persons of any position in this part of Java.

Under his guidance we visited the royal stables and carriage-house, the spacious audience hall and zoological garden, and partook of lunch in the upper room of the clock tower, which commanded a fine view of the enclosure. Here a great variety of food and drink was offered to us by numerous native servants, all presented to us in the servile, squatting attitude assumed in the presence of royalty. Descending, we resumed the rounds of the palace, and everywhere encountered an army of officials and servants. Presently a middle-aged woman, dressed in the careless garb of the country, separated herself from a group of retainers and, walking up to the prince, shook his hand with great assurance of manner. We were informed by our European friends that she was the chief woman official of the palace, for the time being in undress costume. With her frouzy, gray hair, and a great ball of tobacco protruding from her lips, this Javanese mistress of the robes made anything but a courtly appearance.

Thanking our kindly host, we returned to our hotel and, later in the day, went shopping in the busy streets of the town. From a Chinese merchant we secured a number of krises or small swords, said to be of ancient date, but with wooden handles which had a suspiciously modern appearance. Here as elsewhere a number of women peddlers brought to the hotel samples of the artistic cloths from which the sarongs or skirts of the Javanese are made.

STYLES OF DRESS

The universal style of dress consists of the sarong and kabaya. "The kabaya is a sort of dressing jacket, often embroidered. Under it is worn the sarong, a brightly colored skirt falling down straight and narrow, with one simple, deep fold in front, and kept in place by a silk scarf wound around the waist several times."

Here in Solo the old and the new in dress are often found in startling contrasts. At the court festivals held here it is possible to see groups of Javanese nobles, some in the modified European attire and others in the ancient court dress of the country. During our stay we were invited to an evening reception, given by the prime minister of the Sultan, and all the native men present as guests wore the modified European costume. At least once a year the prince gives a great entertainment, when he dispenses a truly royal hospitality. Hundreds of natives and Europeans are invited to the festival, and the best actors and dancers are engaged. After one of these entertainments it is said all sorts of tableware and bric-à-brac are offered for sale in the city—a result of the wholesale thefts on the part of the servants, who seldom receive any pay and take this means to "get even." It is said some one remonstrated with the Soesoehoenan for permitting this condition of affairs to

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"THE THREE GRACES": BRAMBANAM

exist, and he is said to have answered: "Who can my people steal from if they cannot steal from me?"

THE RUINS OF BRAMBANAM

From Solo we made an interesting excursion to the ruins of the temples at Brambanam, which are believed to date from the ninth century and form eloquent monuments of the grandeur of the period of Hindu dominion in Java.

We first visited what remains of the temples dedicated to Lara Jonggran, known in India as the Goddess Durga.

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RUINS OF CENTRAL TEMPLE: BRAMBANAM

Passing the remains of three circular walls, we arrive at the inner area which embraces the ruins of eight pyramidal structures. One of these contains, in one of its four compartments, the eight-armed bronze figure of the goddess which gives the temple its name. A broken statue of her consort, Siva, stands in the inner chamber of this temple, while in the western chamber sits a striking image of Ganesha, the elephant-headed god of wisdom. The images in another temple, dedicated to Siva, are especially notable for a certain dignity of expression, and

are in the main well preserved. In another group of ruins is found a well-executed representation of three women popularly known as "the three graces."

After an hour's repose in a rest-house near the ruins, we entered carriages drawn by four stout little ponies and sped along over well-kept roads toward Djokjakarta, the seat of the second so-called independent prince. The main roads in this part of Java are lined with noble trees and the ride in the late afternoon was one of pure delight. We passed many villages and marveled at the density of the population and the fertility of the land which nourished all these teeming millions.

JAVANESE DANCERS

Arriving at last at Djokjakarta, we established ourselves at a comfortable hostelry and put in two days in viewing the sights of this historic locality. This was the last citadel of native rule on the island and after the final conquest of this eastern empire, in the Mataram war of 1825, Dutch control of Java became supreme. The present Sultan is nothing but a puppet king; but, with the large annuity paid him, he is able to maintain an outward show of royalty, as is evidenced by a showily-uniformed bodyguard and a small army of native officials.

These people are passionately devoted to the form of dramatic art known as the Wajang Wong, and to the dances given by their Bejadas, or ballet troupes. Some of my readers will doubtless recall having seen the performances of one of these troupes at the Chicago World's Fair. Their dancing is of the measured, serpentine style, with many graceful turns of the hand and postures of the body. No account of Java would be complete without some reference to the Wajang Wong. There are two forms of these plays, one in which leather puppets are employed, and the shadows of these puppets are thrown on a curtain and the talking is done by a man behind the scenes. In the other form of this drama the characters are taken by living persons. In both instances the plays deal with mythological subjects and serve to perpetuate the ancient epics and legends of the people. I attended one of these performances at the house of a rich native. Of the seven actors, four were women, and music was furnished by five performers. The leader of the orchestra recited the words of the archaic drama, modulating his voice according to the character. All the actors wore masks with prominent hawk-like profiles. The action of the play related to the doings of gods and mortals. The masks were of different colors: gold for gods, white for giants or great men, red or black for devils, and brown for Javanese.

THE GLORIES OF BORO BOEDOER

Just after sunrise one morning we started in carriages for the site of the most famous of all the ruins at Boro Boedoer. It was exhilarating to roll along through this region of mid-Java, illustrating the perfection of tropical landscapes. We encountered hundreds of natives hurrying along, carrying their burdens to a near-by pasar or market. On reaching the village of Temple, where the market was held, while the horses were being changed we had an opportunity to observe hundreds of these brown-skinned people trafficking in their farm produce and exchanging the gossip of the neighborhood. Resuming our journey, we would come at intervals upon villages buried away in the shade of dense tropical forests, and whose existence was unsuspected until we arrived in their midst. Here, in his humble home, the happy, care-free native lives close to nature's heart and concerned with nothing but the performance of his share in the cultivation of the village rice-fields.

The glories of Boro Boedoer have been amplified by every traveler who has visited this ancient shrine, and it would take an entire paper to do justice to its many marvels.

I shall quote a short passage from a recent description of the ruin: "The temple, which is believed to have been built during the end of the ninth century, was

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GANESHA, THE ELEPHANT-HEADED GOD: BRAMBANAM

not discovered until the period of English occupation, when it was partly laid bare by the removal of earth and ashes that had been heaped up against it during centuries of eruptions from neighboring volcanoes.

"Of its kind, the temple is probably the largest Buddhistic edifice in the world, its prominent position on the summit of a hill, above which it towers to a height of 120 feet, lending additional dignity to this marvelous pyramid. . . . The temple consists of a number of terraces, built on a square ground plan.

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BODYGUARD OF THE SULTAN OF DJOKAKARTA (SEE PAGE 104)

Stairways lead to the top from each of the four sides. Rising from the summit is a dagoba, which contains a gigantic image of Buddha.

"An idea of the magnitude of the structure may be gained from the fact that there are over 988 bas-reliefs in a good state of preservation, illustrating the life story of Buddha, while 441 images of Buddha, each within a small dagoba or shrine of its own, are still in existence."* The five lower terraces are

*"A Cruise through Eastern Seas," p. 139 (Ed. Stanford, London, 1906).

of square design, while the three upper terraces are circular.

We marveled at the beauty and chasteness of the bas-reliefs, copies of which attracted so much attention at the Paris Exposition of 1900. The latticed dagobas on the upper terraces are said to be quite unusual in design. "The whole is a splendid epitome of Buddhism just before its decline."

After our protracted sojourn in the rich lowlands of mid-Java we were in the humor to enjoy a week's stay in the cooler air of a delightful little resort known as Garoet, situated in a wide valley in the southwestern part of the Preanger district, at an altitude of nearly 2,400 feet above sea-level, and completely surrounded by volcanic peaks.

One of the pleasant features of travel throughout Java was the friendly attitude of the people toward us. Everywhere we were received with smiling faces and treated with courtesy. Every day during our stay at Garoet we were serenaded by a band of youthful musicians, whose instruments were made of bamboo. By an ingenious sliding device, when the position of the instrument was reversed, impact was made upon the cylinder of bamboo; thus each instrument made its individual note, and, among them, they produced the complete octave.

Many charming excursions can be made from Garoet. I shall refer to one which we made to the crater of the volcano of Papandajan, about seventeen miles distant. We had grown accustomed by this time to early starts, and so did not resent being called at half-past three in the morning. An hour later we entered a wagonette-like vehicle drawn by three horses and drove southward over the undulating surface of the valley. The dawn came at length, and we met many peasants on their way to begin their daily toil in the rice-fields.

IN THE RICE-FIELDS

In Java rice is the staff of life, and the energies of the people seem to be devoted more to its culture than to any other industry. On this drive we had an opportunity to see how it is harvested by the natives, who are apparently able to work all day under the burning sun without inconvenience.

Water is an absolute necessity to its successful culture. By a series of irrigating canals it is led to an upper field from which the water is drained from one terrace to another. In fields where the rice had matured we beheld numbers of peasants cutting the stalks with hand scythes in the old, old style which obtained in the days of the patriarchs.

Later the sheaves are bound in neat bundles and piled together in small stacks. The finest grade of rice is said to come from Japan, but Java rice is also highly esteemed in the markets of the world. In this land of dense population and struggle for the mere necessities of life the human animal is the carrier of burdens, and we found many troops of men transporting the rice to the storehouses. While walking about the village one day I met a company of women engaged in the same service—patient creatures performing their allotted tasks without a murmur.

But the sun is already making its presence felt, and we have covered the first eleven miles of our journey and arrived at Tjiseroepan, a quaint village at the base of the volcano, with houses having peculiar, steep roofs of thatch unlike those seen elsewhere. Beyond here it is impossible to go in a vehicle, and one must choose between a mountain pony and a palanquin.

The six-mile trail to the crater leads at first among coffee plantations and past fields of cinchona trees; but soon we leave all signs of cultivation behind and enter a true tropical jungle, where nature seems to run riot in its many forms of beauty. All about us we see examples of tree-ferns with orchids clinging to their trunks, banks of giant lantana bushes, and occasional clusters of the purple trumpet flower of the deadly belladonna plant. Lofty, overarching trees, with huge creepers trailing from their branches, and groves of the graceful bamboo, made a lovely picture. As we

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EUNUCHS IN GROTESQUE COSTUME: DJOKAKARTA

approached the crater plant life became less prolific and finally gave place to a stony waste, where we crossed rivulets of hot, ill-smelling water. At length we dismount and clamber up the last few steps on foot to the rim of the crater. Following our native guide, we descend into the crater and make our way over the treacherous ground, which is very hot in places. We wonder at the stoicism of our guide, who wears no shoes on his feet. We make our way over the

Photo and Copyright by C. H. Graves

GROUP OF DANCERS AT A NATIVE FESTIVAL: DJOKAKARTA (SEE PAGE 104)

broken surface amid hot vapors, past many mud springs and vent holes whence malodorous gases come forth. In a way the place recalls the Devil's Kitchen in the Yellowstone National Park, although the Javanese name Papandajan, meaning "smithy," is just as descriptive in its way.

THE BOTANICAL GARDEN AT BUITENZORG

With many regrets we leave Garoet, with its cool airs and homelike hotel,

WOMEN CARRYING RICE: GAROET Photos by H. G. Bryant

VICTORIA REGIA LILIES: BOTANICAL GARDEN, BUITENZORG

for Buitenzorg, passing on our way the celebrated plain of Leles, which furnishes an example of the elaborate system of land cultivation which prevails in Java.

Buitenzorg ("without care") has a charming situation 870 feet above sea-level, and contains the residence of the Governor General and the famous botanical garden. First impressions count for much, and in this instance the view from our hotel window of the river valley sweeping down from the slopes of Salak mountain was one worth remembering. A short walk brings us to the Botanical Garden, which we enter by a noble avenue of Kanari trees, whose overarching branches form a vault of living green. The garden, which comprises 90 acres, was established by the German naturalist, Reinwardt, in 1817. An annual grant of $50,000 is made by the government for its maintenance.

After visiting other celebrated gardens at Kew, Calcutta, Peradeniya, and the Castleton Gardens, of Jamaica, I cheerfully award the palm of excellence to this one, where man has done much but nature more to develop a veritable paradise of the horticulturist. Wherever one turns charming vistas meet the eye, and we were especially interested in searching out the useful bread-fruit tree and the curious sausage and candle trees. The arrangement of the specimens in family groups adds much to the educational value of the garden.

In the retrospect of travel in this favored isle, the memory of this lovely spot will always stand for what was best "in that enchanted garden men call Java."

AN ANCIENT CAPITAL

By Isabel F. Dodd

Professor of Art and Archeology in the American College for Girls, Constantinople

No archeological discoveries of recent times are more interesting than those made in the last three years of the ancient Hittite civilization in Asia Minor. There are references to the Hittites in the Old Testament (Genesis xxiii, I Kings xi, II Kings vii), but little has been known of them until very recently. The excavations at Boghaz Keouy and elsewhere in Asia Minor prove that the Hittites were a powerful and civilized race who ruled practically all of Asia Minor 4,000 years ago. Hittite warriors overthrew the first Babylonian dynasty about 1800 B. C., and they also checked the victorious advance of the Egyptian kings in Syria and Palestine.

THE traveler who has taken the strenuous journey of eight or more days from Constantinople to Boghaz Keouy will thank his lucky stars that he persevered; that he surmounted the obstacles of bad roads and worse inns and reached that marvelous place.

Of late years the whole reading world has become interested in the Hittites, and, though the sculptures of Boghaz Keouy and the fact that it was an ancient Hittite center have been known for many years, it was not until the excavations were begun there, in 1906, and carried on in 1907, by Professor Winckler and Macridy Bey, that any one realized what a place of wonders it is.

Boghaz Keouy means the "village of the throat," for it is at the end of a deep valley that the modern Turkish village lies, in northern Cappadocia, and the Hittites of the sixteenth and fifteenth

Photo from Smithsonian Institution

THE GREAT CITADEL IN THE CENTER OF BOGHAZ KÖUY (SEE PAGE 113)

centuries B. C. built their great fortified city on the rocky hillsides above the mouth of this valley.

Whether it was Subbi Luliuma or some other musically named gentleman who laid out this city of many great buildings and strong fortifications, he certainly possessed an appreciation of natural beauty as well as statesmanship, for, as one climbs from point to point—from the palace up to the great citadel; from one rock, crowned with massive ruins, to another still more stupendous—one hardly knows which to wonder over and admire more, the strength and skill displayed in these three or four thousand year old remains or the glorious views that greet one's eyes at every turn.

Photo by Isabel F. Dodd

THE HITTITE DOUBLE-HEADED EAGLE

From one corner of the citadel, by the remains of a round tower, you look straight down four or five hundred feet of rock into the gloom of a narrow gorge, at the bottom of which a stream flows darkly, and you can see little but the rock over which you lean, and the swallows that flash in and out of the gorge, and the eagles that sail to their nests on the opposite crags. On another side of the citadel, at the foot of the precipice, the same stream winds softly through trees and grass and flowers, where willows whiten in the breeze and a mill clacks merrily. Here we saw the rare black stork sail proudly through the valley and heard the rock doves cooing in the caves.

On the less steep side of the citadel there have been several trenches dug by the excavators. In the earth thrown out of these trenches some peasants have planted their grain, and thus, fertilizing their seed with Hittite remains, they have raised an abundant crop with little labor.

All over the flat top of this acropolis, as well as everywhere else in the city, one may pick up any quantity of broken pieces of ancient pottery—brown, black, and every shade of red and every degree of fineness. Much of this pottery is painted, most of it with simple decoration resembling that on the proto-Corinthian or geometric vases. Some of it has a beautiful glaze; some is covered with a white slip and painted in three or four colors, while most of it has simply black or dark red markings on red pottery. These pieces are found in the earth below the regular wall of the citadel, as well as above it, thus showing their great age. Here and there are pieces of enormous pithoi, evidently used by the Hittites for storehouses, as by the Greeks.

ASSYRIAN CUNEIFORM CLAIMED MORE IMPORTANCE THAN DID LATIN

A visit to Boghaz Keouy not only makes one feel quite intimate with the Hittites, but also one sees here that they did many of the things that we associate with much later peoples. Did the Turks first use the star and crescent; or even the Greeks of ancient Byzantium? No, indeed; here at Boghaz Keouy (and in the later Hittite city, newly excavated, near Aintab, in South Turkey) the star and crescent may be seen where it was carved in the rocks a thousand years before Byzantium was founded.

Did the Austrians or Russians, or the old Byzantines, or the German Empire, first use the double-headed eagle? None of them. Everywhere in Hittite sculptures we find this symbol. The first peo-

THE EAST GATE, FROM WITHIN (SEE PAGE 116) Photo from Smithsonian Institution

ple, probably, who practised the noble sport of falconry were the Hittites—so the sculptures tell us. And in that connection it was interesting to hear from the Turkish bey, who is the overlord of all this region, that he and his friends train and use falcons in hunting now, and are very eager in the sport.

Was it Rome that first made the proud boast that all roads lead toward her? Professor Ramsay tells us that all the roads of more ancient times met in Boghaz Keouy. Was it only in medieval Europe that there was one writing and language used for general communication between nations, and for learning and literature? Assyrian cuneiform claimed more importance and a greater vogue than did Latin, since for three thousand years and more it was the language of commerce and literature among all the civilized nations of the world. And to these civilized nations belonged the Hittites.

Here on the citadel in 1906 the explorers unearthed a library of clay tablets all written in cuneiform characters, some of them in the Hittite language, but more in the Assyrian. All these tablets have been taken to Constantinople, to the Museum, and are awaiting the reading that will give us, we hope, much new light on the lives and thoughts of the Boghaz Keouy Hittites.

Of the tablets that have been read, one gives the Assyrian text of the treaty between the great Rameses of Egypt and the powerful Hittite king Khattu-Sil—that treaty of which the Egyptian text was already well known to historians.

And another tablet, as Professor Sayce tells us, shows how much women had to do with politics in those far-off days, since it is a letter from Naptere, the wife of Rameses, addressed to the Hittite Queen, and expresses her great satisfaction over the conclusion of the treaty.

In the summer of 1907 another great library was found in two rooms at the eastern side of the palace. Some of these tablets are very large, 12 x 8 inches in size; others are but 2 inches long. They are mostly of about the same time as the Tel el Amarna tablets, and so cover the age of Moses.

Professor Sayce also tells us that many of these Boghaz Keouy tablets were written by the same disaffected governors of Syrian provinces, who, in the Tel el Amarna tablets, write to Pharaoh of the difficulties in the way of maintaining the rights of the Egyptian government in Syria, but tell how nobly they were working in their lord's interests, while in these newly found writings of Boghaz Keouy the same men tell the *Hittite* king how they are pretending to be the humble servants of Egypt while really obeying the commands of Khattu-Sil, and the political intrigues that are here displayed and the polite sarcasm and meaningless phrases that pass between these old writers might give points to modern diplomatists.

NO KEY TO THESE TABLETS HAS YET BEEN FOUND

Although all the tablets discovered two or three years ago were carried to the Constantinople Museum, the shepherds and laborers who wander over these hills pick up occasionally broken pieces of tablets, and, knowing that any writing on clay or stone seems precious in the eyes of "these queer Europeans," they offer what they find for sale to any passer-by. As one eats one's dinner a boy appears, and, squatting on his heels, produces a few bits of clay from his girdle, or wrapped in a handkerchief (which challenges comparison in age and in dirt with the Hittite contents); or one is awakened in the early dawn by a head stuck between the curtains of the tent and an insinuating voice saying "kyramidi" (clay tiles), the owner thereof being anxious to strike a bargain quickly, before he takes his sheep up on the hills above.

So far, I believe, no bilingual has been found among the tablets; that is, no writing which repeats the same thing in both the Hittite and the Assyrian languages, and which would perform the office for the Hittite which the Rosetta stone performed for the Egyptian hieroglyphics. But the sudden stopping of the history

Photo by Isabel F. Dodd

THE FIGURE OF THE AMAZON ON THE EASTERN GATE

which the tablets tell, as well as the condition of the ruins unearthed, shows us that some time in the thirteenth century B. C. the great city was destroyed, probably by a sweeping down of some barbarian horde, thus anticipating (long ages before) the story of the destruction of Rome. And this Hittite capital was never again inhabited or rebuilt, for there is apparently no trace of Greek or Roman work or influence in the remains. The Hittite power, however, was not destroyed then. Cilicia and the southern part of Cappadocia have numerous monuments which show occupancy by Hittite people till about the eighth century B. C.

What is considered the latest of known Hittite works is the rock sculpture at Ivriz of the god of the harvest and a worshiping king; and this Ivriz, near the Cilician gates, is one of the most beautiful spots in all Asia Minor. The sculptured rock rises above a green dell, through which flows such a mountain stream as fills one's heart with singing. Salmon trout are found in great numbers in its rushing, green waters.

These fish the modern Hittites (and perhaps they learned it from the ancient ones) catch in what any sportsman would declare to be a most iniquitous manner. They use no hook or line, but beat out the juice of a certain milkweed and spread this juice on the water. The trout is intoxicated by it, turns over, and, floating, is picked out by hand. They say that the fish entirely recover in a bowl of fresh water, and that the intoxication does not injure the flesh for food. That the salmon trout caught in this Hittite way taste particularly good I can testify.

The great Ivriz figures by the mountain stream have been known and visited by Europeans for ages, but a replica, much worn and weathered, has lately been discovered two miles farther up a wonderful gorge, where great rocks like those at Boghaz Keouy nearly meet overhead, and here is shown that persistence of sacred traditions about one place which has often been remarked upon, for here also the ruins of three Christian churches cling to the sides of the gorge.

THE AMAZON OF THE EASTERN GATE

As we walk away from the citadel in Boghaz Keouy to see the various points of special interest within the five-mile circuit of the ancient walls, we come first to the one place on this site where there has been found any inscription in the Hittite hieroglyphics (those hieroglyphics which are so common all through the more southern Hittite country). This one inscription of Boghaz Keouy is so badly worn by time and weather that it is quite illegible. Further down the hill slope we come to the Eastern gate. Like the other city entrances, this has two parts, with a square room between the outer and inner gate. The posts of the real door curve in toward the top, as if they once formed a pointed arch. This Eastern gate has long been known and is

THE LION GATE

of grand proportions, but it is only since the archeologists left here, in 1907, that the workmen discovered, almost by accident, on the inner side post, a remarkable bas-relief.

This is a figure, about ten feet high, of an Amazon, apparently, and bears little resemblance to the figures found in other distinctively Hittite places. It is carved in high relief and finished with great care, even to the finger and toe nails and the delicate metal work of the breast-plate. Having been so recently uncovered, the fineness of its workmanship is excellently preserved, and we can trace all the details of the curious headdress, lappets of which fall over each ear and down the back, while the flowing hair shows clearly beneath the long back lappet. This Amazon has a strong, masterful face, and the treatment of the eye, as well as other details of the carving, seem to belong to some later period than the rest of the city. She wears what seems like chain armor over breast and shoulders, and a short skirt ornamented with rows of lines and circles. She carries a double-headed axe in her right hand and has a short sword girded to her side. The strongly accented muscles of her legs look like Assyrian work, and her feet are bare instead of being encased in pointed Hittite shoes.

SECRET PASSAGES AND TUNNELS

We leave this gate and walk over fields and hillocks to where the wall or fortification forms a high bank, rising eighty feet or more from the fields each side. Here there are two interesting mementos of the Hittites—a tunnel through the fortifications and steps up the bank. There are two flights of these steps, made of limestone, about six feet broad, low and easy, varied by occasional platforms. The tunnel is about one hundred and eighty feet long and perhaps ten feet high in the middle. It is formed of unhewn stones of uniform size, and the ceiling is a true pointed arch with keystone. There are a number of such tunnels as this to be found in Boghaz Keouy.

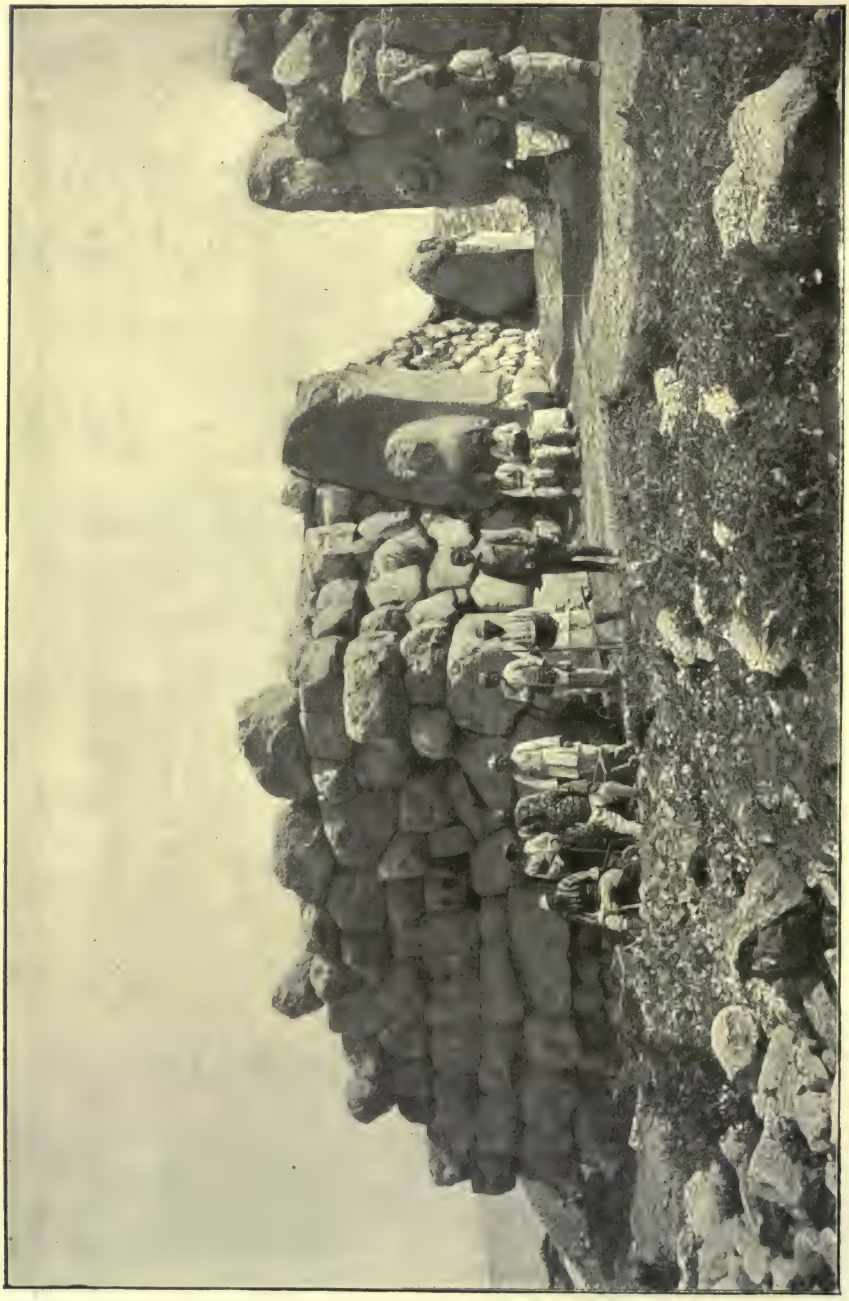


Photo from Smithsonian Institution

ANOTHER VIEW OF THE OUTER SOUTH GATE, WITH LIONS, AND OF THE LEFT TOWER

THE PICTURED ROCKS AT BOGHAZ KEOUY

Of some only the postern appears, and some are filled with débris and can be penetrated but a short distance.

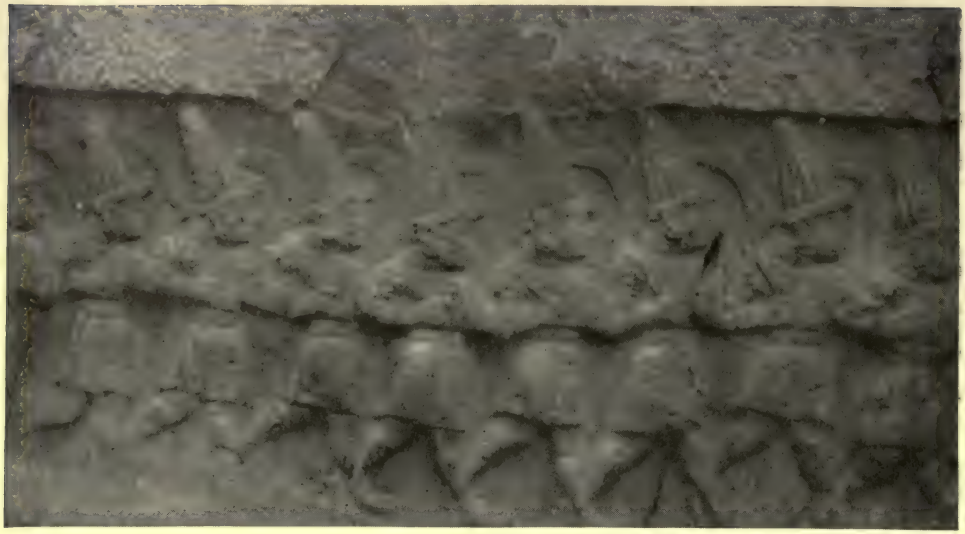
It seems to have been a Hittite habit to build such underground passages, and this habit was continued by their relatives or imitators, the Phrygians. Professor Ramsay tells us of several secret passages connecting different parts of Hittite and Phrygian fortifications, or an acropolis and some more or less distant hill. This tunnel ends on the outside in a post and lintel gate, with grooves for a door and holes for the closing-bar. On the citadel there was one specimen of the ancient Babylonian door-socket, well worn, but worn into a block of limestone squared and cut as perfectly on all sides as if for a modern building.

Once more following the wall, we come to the famous Southern gate, which admitted to the city the commerce and travel from Cilicia, and which is still guarded by the lion posts, always pictured in every description of Boghaz Keouy. Fine, upstanding lions they are, too, with wide-open jaws and curly hair.

From between the lions one looks outward and downward to a marvelous stretch of hill and dale, while on the inside we look across the mile and a quarter of the city limits, sloping down from this point 870 feet to its northern end. Here and there on the slope rise the great rock fortresses, each bearing on its summit more or less of Hittite masonry. Beyond the northern side of the city stretches a wide and fertile plain which must have furnished the greater part of the sustenance of the capital.

THE PALACES

We also see from this gateway, or on the road to it, a number of palaces whose foundations have been uncovered in the course of the excavations. The largest of these lies on the lower part of the slope and is about 208 feet long by 138 feet wide. It consists of a great central hall and many chambers on each side. On the south side and on the southeast corner there seem to have been splendid entrances with double gates, small courts between, and pillars at each corner. The stones which form these courts, and especially the thresholds, are most beautifully worked with a curved and beveled edge. The stone used is largely the limestone of the region, but part of the pavement of the great hall and many other parts of the building were of imported trachyte.



THE REAPERS IN THE SMALL GALLERY (SEE PAGE 122)

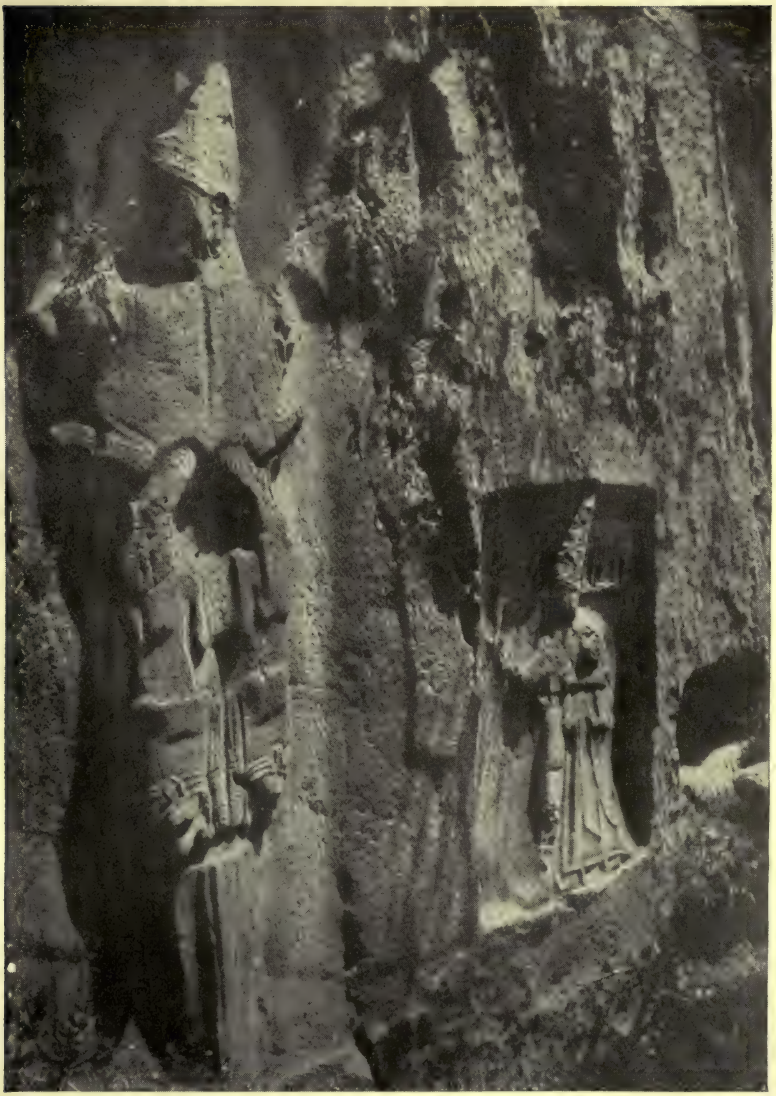
From the lack of any stones which could have formed the upper parts of the building, and from the holes drilled in the upper side of the stones at regular intervals, it has been conjectured that the buildings were of wood, covered within with clay tiles, and were entirely burned at the time of the destruction of the city. This would also be shown by the charred remains found everywhere in the ruins.

One cannot but wonder how the Hittites kept themselves warm in their palaces, what kind of stoves they used, or if they had a central heating plant, and whether it was for hot water or steam. It is a place of very cold winters nowadays. From the great stone bath-tub at one corner of the palace, in a trench, and from the clay receptacle (surely a bath-tub!) in the Hittite room of the Constantinople Museum, we are convinced that the Hittites loved cleanliness.

The lower end of the palace is built upon terraces to correct the slope of the hill. On the northern side, also, is what has been called a sanctuary, a large room with an especial entrance, and what may be an altar, upon one side, while on the other is a small cistern or basin of rock. The Armenian cook of our expedition was inspired by the atmosphere of interest in antiquities, and went over this palace, pacing each room carefully and bringing back in triumph a broken wooden spoon and the lower jaw of a dog. As he displayed his Hittite relics he looked with contempt at the pile of broken potsherds which we had gathered. Crestfallen as he was over the lack of appreciation which greeted his finds, he was later the first to discover some real antiquities. It was the evolution of an archeologist.

NO MORTAR WAS USED ON THESE GREAT BUILDINGS

Time would fail me to tell of all the splendid masonry found on each of the rocky heights of Boghaz Keouy, all made of great stones, one fitted into another by a peculiar sort of curved edge, without mortar. "Yellow Rock" (as it is called) has the most of the building remaining. "Yenije Kaleh" (somewhat new rock) has the most heart-gripping height and extended view. "Storehouse Stone" has many rock-hewn chambers, now used by the shepherds. "Curious



THE LION-BODIED FIGURE IN THE SMALL GALLERY (SEE PAGE 122)

Rock" has a great curved niche hollowed in one side, as though for a colossal statue. Another smaller rock is split in two and has hollows carved all over the top, like old dew-ponds, while at one side is a place with three cut steps just like the altars of Cybele in Phrygia. Still farther down we find "Maiden's Rock," low and flat. No one knows why it is so named. Perhaps the ancient Hittite maidens used it as a dancing floor. Over on the other bank of the river is another great rock with a similar redoubt on its head.

The wall which surrounded the city was of the most solid character; where it remains it is about 14 feet thick, the center a 6-foot core of rubble, while each side is a 4-foot thickness of finely dressed stone.

LOOKING TOWARD THE NORTH IN THE GREAT GALLERY AT BOGHAZ KEOUY

THE PICTURED ROCKS

The real temple of the Hittites of Boghaz Keouy is considered to be found in the so-called "pictured rocks," a mile and a quarter to the east of the city. Over 500 feet above the valley we find one group of rocks, with no difference in its outward appearance from many another, but distinguished by two galleries, both faces of which show a remarkable series of pictures. The galleries now have no connection, though it is supposed that there was originally a way from one to the other, now filled with fallen stones.

The smaller of the two galleries has on one side 12 figures with Phrygian caps and turned-up shoes, carrying reaping hooks over their shoulders.

Opposite them is a strange figure, whose head is human and who wears the usual pointed cap and big, round earrings, but whose body is formed of lions—the shoulders of two half lions, jaws outward, while below these two other lions, head downward, seem to form legs. We know that Cybele, the earth goddess of Asia, was represented with lions as constantly as St. Jerome was in the early renaissance paintings, and it would seem as if these pictures were connected with her worship, the reapers but adding to the probability.

Also, just beyond this weird, lion-bodied goddess is a group of much better workmanship that may be a priest and king, or another god and the king. The god, if it is he, with Hittite cap and shoes and sword, is about six feet high, and is holding his arm about the neck of the smaller figure, who carries the curved lituus, so often seen in Hittite pictures, and who wears a flat cap and long robe.

In the large gallery there are many

THE HITTITE GOD AND KING (OR PRIEST) IN THE SMALL GALLERY AT BOGHAZ KEOUY

more figures, about 67, though some have grown indistinct of late years.

This gallery is more than 90 feet long—a great hall open to the sky, where the Hittites have united art and skill with the use of all the natural advantages of the spot. The floor in some places is simply leveled rock, in others a pavement so cunningly fitted to this that it seems all natural rock floor. The figures, who march from the open side of the hall toward the opposite closed end, are mostly in panels, and are smaller at the entrance, gradually increasing in size to the middle of the north wall, where the two processions meet face to face. I think this increase in size relates to the importance of the characters figured rather than to any Hittite idea of perspective.

There is much difference between the figures in regard to the workmanship, whether because of different periods in art, or simply because made by more or less skillful artists, we cannot tell. Some of the figures are partly or quite covered with a very fine brown enamel or thin, hard stucco, and these are, of course, the best preserved. Some are broken—parts gouged out, probably by the vandal boys of the neighborhood, through mere love of destruction.

There are rows of figures—12 in one place, 13 in another—something like the reapers in the small gallery. Then there are symbols and heraldic signs, and, toward the head of the procession, the figures stand on two mountains, or on the double-headed eagle, or on the necks of captives—these things indicating that here are gods or kings. Sometimes we see the crenelated crown, which, on ancient coins, indicates that the one who wears it represents the city. Some of the figures are dressed in accordion-pleated skirts and plain waists; one has an overskirt and a trail under it. A few wear the little flat cap, more the high, pointed Phrygian one. Some have sleeves almost as long as if they lived in the fourteenth century A. D. Some carry flowers, while almost all wear jewelry, either bracelets or ear-rings; but, unlike the Assyrian figures, there is little embroidery on their robes. Many of them (as has the Amazon at the Eastern gate) have a horn either on the cap or somewhere about them. They do not have the very large nose and inane expression of the Hittite sculptures of Cilicia. Indeed, the features are rather intelligent and refined.

The meaning of these carvings and of this great rock hall which holds them is still a problem. Was this a sanctuary of the earth goddess, and do these processions show the king of the land coming with his priests and his family and people to devote all that he has to the goddess? Or do they commemorate some special event, or represent some rites of nature worship? What are the meanings of the various symbols which accompany the single figures? It may be that the reading of the tablets that are found in Boghaz Keouy will answer all these questions.

Here in Turkey nowadays we are not only searching out much old history, but we are rapidly making new history. The bey of this district (the descendant of a Seljukian Sultan) exercises a truly Eastern hospitality, entertaining freely all visitors to Boghaz Keouy, rich or poor. We had camped on the hillside above the Hittite palace, and the bey came up the first night we were there to protest against such an infringement of his hospitable rule. This Turkish gentleman is deeply interested in the history connected with his land, and took pains to point out to us various places which, in his opinion and that of the archeologists, would be likely to yield important results if excavated. He has three fine boys, the youngest but an infant. The other two have been sent to school in the neighboring town, and he plans to have the oldest go to an agricultural college and the second to become a physician, that they may both work for the health and prosperity of his people.

Perhaps some day a new city will crown these splendid heights, and a happy and progressive people, under the good government of Young Turkey, will build up the life and associations which will make this beautiful spot once more famous.

THE INTERNATIONAL MILLIONTH MAP OF THE WORLD

By Bailey Willis, U. S. Geological Survey

FOR whatever the stature of his guest, however tall or short, that bed fits him to a hair. Because, if a man be too tall for it he lops his limbs till they be short enough, and if he be too short he stretches his limbs till they be long enough. Therefore is he called Procrustes the Stretcher."

Turn the leaves of any atlas and view the countries, large or small. How they are all fitted to the Procrustan page, some drawn to one scale and some to another, but all finally compressed to the same size in the atlas, although widely different in fact. Here is Colorado with 103,925, or Wisconsin with 56,040, or Massachusetts, Connecticut, and Rhode Island, all three together with but 14,555 square miles; but the last, like the first, precisely fills the page. If, in Massachusetts, there be two towns 12 miles apart, there is an inch between them on the map, but if in Colorado there are two 29 miles apart, they also appear upon the map within an inch of one another, the scale in the one case being 12 miles to the inch and in the other 29 miles to the inch.

This adjustment of the maps in an atlas to different scales to suit the size of the page appears necessary, because each page should be fully covered and the states or countries which need to be separately mapped are very unequal in size. In local thought the county is larger than the state and the state larger than the whole country, and atlases are made for local use.

But if we would take a broader view of the world and of nations, wishing to know something of the comparative size of countries—that France, for instance, is about four-fifths as large as Texas—it would be at least a great convenience to have an atlas of the world in which all lands were mapped to the same scale. Such an atlas the International Millionth Map of the World is to be.

The name signifies that the map is to be drawn on a scale of one to one million; that is, that any length measured upon the map is to be one-millionth part of the distance between the same two points measured on the ground. In the metric system this is equivalent to saying that a meter on the map is equal to a million meters or 100 kilometers on the ground. In our English measure it is equivalent to about sixteen miles to the inch. This is a fairly large scale, which allows the engraver to delineate villages as well as cities, railroads and the principal roads, all water-courses of note, and the general features of hills and mountains. Yet the scale is also such that a sheet of convenient size may represent a large area, on an average equivalent to a State of the United States, and thus the scope of the map is sufficiently generous to be useful.

Both in scale and scope we may contrast this one-millionth map with others which are made available to the public by the government surveys. The detailed topographic maps of the United States, which are prepared by the United States Geological Survey from original surveys, are published on a scale of one mile to an inch for the more densely settled regions of the country and of two miles to an inch for the less developed regions. This scale is so large that it is possible to show individual houses, every turn of the roads, and the precise form and altitude of all noticeable hills. With these maps, in advance of other surveys, an engineer may plan the route of a road or even a railroad through a hilly or mountainous country. Thus they are adapted to all detailed studies of local features, but their scale is so large that their scope is very

small. By train or automobile we may traverse the area represented on a single atlas sheet in an hour or two, and one cannot conveniently carry enough sheets to trace the course of an extended journey.

In reducing the scale to 16 miles to the inch we reduce also the details which may be shown, and we must necessarily eliminate the local objects. But that scale is still sufficiently large to comprise all of the essential features which one would wish included in a general view, and the scope becomes such that a single sheet serves for a day's journey.

Maps of various parts of the United States, which approach the one-millionth in scale and scope, are not uncommon. Land Office maps, prepared by the general government, and state maps designed for different purposes have not infrequently been published with 10, 12, or 15 miles to the inch, and for some years past the Geological Survey has had maps in preparation with the design of publishing them on the one-millionth scale. But it has awaited the conclusion of an international agreement before pushing them to publication.

THE ORIGINATOR OF THE PLAN

It was in 1891 that the proposal for a standard international map of the world was first made by Prof. Albrecht Penck, then professor of geography at the University of Vienna and now at the University of Berlin. Professor Penck, who was at that time a young and comparatively little known man, might have found it difficult to arouse interest for his plan except that he was able to bring it before the International Geographical Congress which met in Bern in that year. The geographers who were there assembled knew from their own experience the great inconveniences which arise from the use of maps on many scales, and they appreciated the great advantage which would accrue to the study of geography if we could but have one standard map on a uniform scale. They therefore took up the project, passed resolutions favoring it, and committed the plan to a committee with instructions to report at the succeeding congress.

The members of the committee represented ten different countries and were twenty in number. The list of names includes the leading geographers of the time and men high in official rank, whose duties in other directions were already onerous. Mr Mendenhall, superintendent of the Coast and Geodetic Survey, and Major Powell, director of the Geological Survey, represented the United States. It might have been foreseen that so large a committee would be ineffective, because it was impossible to assemble the members for discussion. Recognizing the need of an efficient subcommittee to study the problem and formulate proposals, the general committee invited three representative scientists of Switzerland, at the head of whom was Eduard Brückner, then professor of geography at the University of Bern, to act in an advisory capacity, and to this subcommittee is due the credit of such progress as was made in the development of the question. A report submitted by Professor Brückner at the Sixth International Geographical Congress at London, in 1895,* contains a discussion of all the principal items on which agreement was necessary, and presents clearly the difficulties which arise from different usages in cartography.

But if the general committee failed as an executive body, it served most excellently to make the plan widely known, as is shown by the list attached to Professor Brückner's report of twenty-one articles published in the interval between the two meetings of 1901 and 1905.

At the Geographical Congress held in Berlin in 1899, Professor Penck again brought forward his plan for a world map, but the difficulties of adjusting national differences seemed insuperable. Prominent among these were the absolute refusal of the English geographers

* Brückner, E. Rapport du Président de la Commission pour l'Etablissement d'une Carte de la Terre a l'Echelle de 1 : 1,000,000. Report of Sixth International Geographical Congress, London, 1895.

to accept the metric system and the insistence of the French geographers upon the meridian of Paris as the initial meridian of the international map.

IMPORTANT PROGRESS AT THE WASHINGTON MEETING

At the Eighth Congress, held in Washington in 1904, Professor Penck took advantage of the fact that France, Germany, and Great Britain had separately prepared maps, on a scale of one to one million, of countries as far apart as China, India, Persia, Africa, and the Antilles, to congratulate the assembly upon the progress made toward the world map. Setting aside as relatively inconsiderable the differences in arrangement and execution of the several maps, he dwelt upon their uniformity of scale and took a hopeful view of the outlook for future agreement. He said:

"It is thus for the first time that different parts of the earth's surface are represented so that they can be directly compared with one another. One who is familiar with Cuba needs only to lay the French map of this island at the side of the German or French map of China to see at one glance that space which has been overwhelmed in the Russo-Japanese war. A student of the coast line can now compare the bays of Shantung with those of Cuba, and another can compare the behavior of the rivers in south Abyssinia with those in south China, and a third will be able, by the chosen projection, to determine the exact areas of lands, rivers, basins, lakes, and so on. All this indicates considerable progress in the practical and theoretical study of different parts of the world—a progress which is not essentially affected by the fact that the maps are not so uniform as was desirable."

After discussing the differences existing among the maps undertaken by the European powers, Professor Penck pointed out that there was no general map of North or South America, or even of the United States, such as any student or traveler requires, and he urged that the Geographical Congress should endeavor to induce the United States to do for America what Great Britain is doing for Africa; that is, to prepare a uniform map of both the American continents on a scale of one to one million.*

The action of the Eighth Congress led to no official result, but the arguments presented by Professor Penck for a general map of the United States bore fruit in the work of the Geological Survey. By authority of the director, Mr Walcott, Mr Henry Gannett prepared a number of maps designed to become part of the one-millionth map of the United States. They were, however, not adjusted to any general plan of the map of the world, as no international scheme had then been agreed to. The units chosen were states, and the drawings were made in accordance with the methods of cartography which have become familiar through the atlas sheets of the Geological Survey. The representation of altitudes by brown contour lines was worked out in great detail for the scale, and peculiarly distinguished the maps in contrast to the effects of shading employed by the French and German cartographers.

Mr Gannett's interest in the project for a world map became an important factor in its further development. At the Ninth International Geographical Congress, held at Geneva in July, 1908, he presented through the American delegate, Dr David T. Day, resolutions urging that the Congress take effective measures toward an agreement upon the essential details of the plan, and that these measures be commended to the several map-making powers with a request for an international conference having authority to act upon them. The resolutions were passed, a committee was appointed, and the details of a plan were worked out and adopted. The British representative, Col. C. F. Close, on request of the Con-

* Penck, Albrecht. Plan of a Map of the World. Report of the Eighth International Geographical Congress, pp. 553-557. Washington, 1904.

In the same report is a notice by General Berthaut, of France, and one by Major Hills, of England, on the one to one-millionth maps in preparation by their respective governments.

gress, accepted the responsibility of presenting to his government a suggestion for a conference at London. And thus the plan which a few years before had seemed hopeless of accomplishment was brought within promise of fruition.

THE CONFERENCE AT LONDON

In the summer of 1909 the British government issued invitations to Austria-Hungary, France, Germany, Italy, Japan, Russia, Spain, and the United States to send delegates to a conference to assemble in London on November 16, with power to agree upon details of the standard international map of the world. All of the governments accepted except Japan, and twenty-two delegates assembled in the British Foreign Office, in the council-room where Lord Salisbury had been wont to hold the meetings of his cabinet.

The sitting of the conference was dignified and impressive. The great square chamber was furnished with a round table, at which all the delegates were seated within convenient range for discussion. There was a touch of old England in the soft-coal fire, which dispelled the chill of London in November, and the bunch of quill pens spread before each member was a reminder of the historic documents that had been executed in Britain's capital.

Under the presidency of Col. S. C. N. Grant, of the British Ordnance Office, assisted by Col. C. F. Close, of the General Staff, the deliberations of the conference were conducted not only with courtesy, but with impartiality and fairness. These officers had but one purpose in view: to ascertain the wishes of a majority of the delegates and secure such an expression of opinion as would lead to a unanimous conclusion. And in this they were signally successful.

In the circle sat men who had been associated with the project since its beginning, and who rightly felt a deep sense of satisfaction in its fruition. Professor Penck, the originator of the plan and now the representative of the Emperor William, was the leading figure, but he took his part with that scientific spirit which effaces the personal element, and a bystander unfamiliar with the past history of the plan would not have known from anything which he said that it had sprung from him. Across the table from him sat Eduard Brückner, who, holding the professorship at Vienna which had been vacated by Penck's transfer to Berlin, was the leading delegate from Austria. France was represented by several eminent geographers, of whom Charles Lallemand, a distinguished geodesist, shared with Professor Penck a commanding position among the foreign delegates. Around the table were many others whose names are well known as teachers and writers on geographical subjects. The delegates from the United States were Mr S. J. Kübel, chief engraver of the U. S. Geological Survey, and Mr Bailey Willis, geologist, of the same service.

FRANCE ACCEPTS THE GREENWICH MERIDIAN AND ENGLAND RECIPROCATES BY ACCEPTING THE METER

The conference took up one by one the proposals of the General Congress and debated them in English, French, or German, as the convenience of any individual speaker prompted. There had evidently been much preliminary discussion at home, and there was a dominant purpose to arrive at a satisfactory conclusion which swept away all the international differences that had previously prevented agreement. The initial meridian of Greenwich was adopted unanimously, without debate. The metric system was agreed to by the English and American delegates, with the provision that the scale of distances might also be stated in terms of miles or of any other unit (such as Russian versts) of the country producing a part of the map. The acceptance of the metric scale extended also to the statement of altitudes above sea, with the proviso that the height in feet may be given in parentheses after the number in meters. The conventional symbols to be used for representing water-courses, roads, railroads, towns, cities, and the

names of various features were agreed to in detail after thorough discussion by a large subcommittee. The result embodies practically all the conventions used by the United States Geological Survey, in the form in which they are employed in the government maps.

"FLORENCE," "ROME," "VIENNA" WILL DISAPPEAR FROM THE MAP

In writing and spelling names the Latin alphabet alone may be used and the spelling shall be that of the official maps of the country represented. Thus the international map will show nothing of Russian or Chinese script. You will look in vain for Florence, but will find Firenze; instead of Rome, Roma; of Flushing, Vlissingen; of Vienna, Wien, and so forth. There was no dissent from this last ruling except in one instance. In odd contradiction to the general liberality of feeling, it was emphatically declared that European geographers could not permit Stamboul, the Turkish name, to replace Constantinople. For China the adopted spelling was to be that of the post and customs service, and in all colonies or protectorates the names are to be spelled in accordance with the usage of the governing country. The delegate from Hungary presented the grave difficulty which confronts the cartographer in the fact that nearly all Hungarian towns have two names, one Hungarian and the other German, and some of them have as many as five names, all of which are currently used by the distinct elements of the population. But it was pointed out that this difficulty affects but one or two sheets of the great atlas of the world, and that the question of choosing among these names might well be left to the Hungarian government.

HOW ELEVATIONS WILL BE INDICATED

There is perhaps nothing which more strikingly distinguishes new maps from old ones, or maps of one nationality from those of another, than the manner in which valleys, hills, and mountains are represented, whether it be by drawing the shapes of mountains, as in Chinese maps, or by covering the paper with short dashes, sometimes called hachures, which show the way the water runs, or by horizontal lines that delineate the contours of the slopes, or by shading with high light and shadow, as if the map were a relief model. Hachures, contours, and relief shading, or combinations of two or even of all three methods, characterize modern topographic maps, and one of the most difficult questions before the conference was to harmonize the various methods in current use.

In maps prepared by the United States Geological Survey contour lines alone are used, and the delineation of mountain forms by means of them has been brought to a higher degree of graphic expression than ever before. This is due to the fact that the American topographer regards his work as a profession rather than as a side issue of military training, which is the position which holds abroad.

In Germany and Austria the method of exhibiting slopes by means of hachures has replaced all other systems, because it is so applied that the proportion of dark lines to intervening light spaces bears a mathematical relation to the steepness of the slope. Level plains are white, and slopes of 45 degrees are almost black, and other slopes are shaded according to their grade. These maps are peculiarly adapted to military purposes, since an officer can judge at a glance the nature of a declivity and whether it is passable by infantry, cavalry, or perhaps artillery; but these advantages do not everywhere have weight, and the method is one which is too expensive in execution and too limited in usefulness to be widely adopted. France has brought relief shading to a very high degree of perfection, and leads the world in the artistic beauty of her topographic maps.

The method of representing the topographic relief of the surface which the conference adopted consists in the main of generalized contours, which shall be so drawn as not to unduly obscure other features of the map, and, in addition,

shading is to be used to bring out those minor features which cannot be adequately represented by contours.

The map up to this point will comprise the representation of streams and all water bodies, of towns, railroads, and highways, of political boundaries, of the topographic relief, and the names pertaining to all these features. It will be what may be called a base map, adequate in itself for all ordinary uses of the student and traveler, but capable of receiving additional data which convert it to a special purpose. In connection with our census, it might be used to express density of population by overprinting different shades of color. Similarly, it might be used as a crop map, a weather map, or a geological map, or to bring out the relations between lines of transportation or works of internal improvement, whether national, state, or private. Thus this base map contains in itself and in its adaptability to a large number of special purposes the highest practicable possibilities for usefulness.

The conference in London, having had its origin among geographers, felt constrained to emphasize the geographic side of cartography, and particularly the representation of altitudes of continents and mountains with reference to sea-level. These relations are indeed adequately expressed by contours, if one examines the map with sufficient care, but it is desirable, especially upon a general map of large scope and moderate scale, to bring the distribution of altitudes more strinkingly into view. To that end the conference adopted a scale of colors, which should be printed on different portions of the map, according to the height above sea. The depths of seas and lakes shall be shown by shades of blue; the lower lands, from the coast to 300 meters (984 feet), by three tints of green, shading into pale buff, which at 500 meters passes into light browns, that grow darker up to 3,000 meters. Above 3,000 meters the brown tints tone into rosy violet, and fade away to white in the highest summits beyond 7.000 meters.

As applied to the United States, the effect of this color scheme will be to exhibit light tints of green and buff over the Atlantic slope and throughout the Mississippi Valley, and from their expanse the Appalachian Mountains will stand out in tones of brown. Similar brown tints will indicate the rising plains between the Mississippi Valley and Colorado, while the summits of the Rockies and of the Cordillera will carry the violet notes of high altitude. On the Pacific slope the bands of color will be closely crowded, bringing out at once the gradations in tint and the relatively rapid rise from the sea to the mountain crests.

THE ATLAS WILL CONTAIN ABOUT 1,500 SHEETS

The arrangement of sheets of the one-millionth map is shown for the northern hemisphere on page 131. It will be noticed that each sheet measures 4 degrees of latitude by 6 degrees of longitude. Thus 60 sheets belt the earth and 22½ sheets extend from the equator to the pole. In the discussions of the conference the execution of the circular sheet covering the northern polar regions within the parallel of 88 degrees was courteously committed to the United States. To represent an entire hemisphere would thus require 1,321 sheets, and for the entire world twice that number; but since three-fourths of the earth's surface is ocean, the atlas will probably never comprise more than 1,500 sheets, including the oceanic islands. These sheets are so designed that they may be fitted together, without appreciable gaps, to any number that may reasonably be placed upon a single wall, and since they will be executed through international cooperation, without reference to national boundaries, according to a uniform style and method, they will really constitute a single great map of the world.

THE MAP SHEETS OF THE UNITED STATES

The sheets which fall upon the area of the United States, including parts of the adjacent oceans and of Canada and Mexico, but excluding Alaska, are 52 in

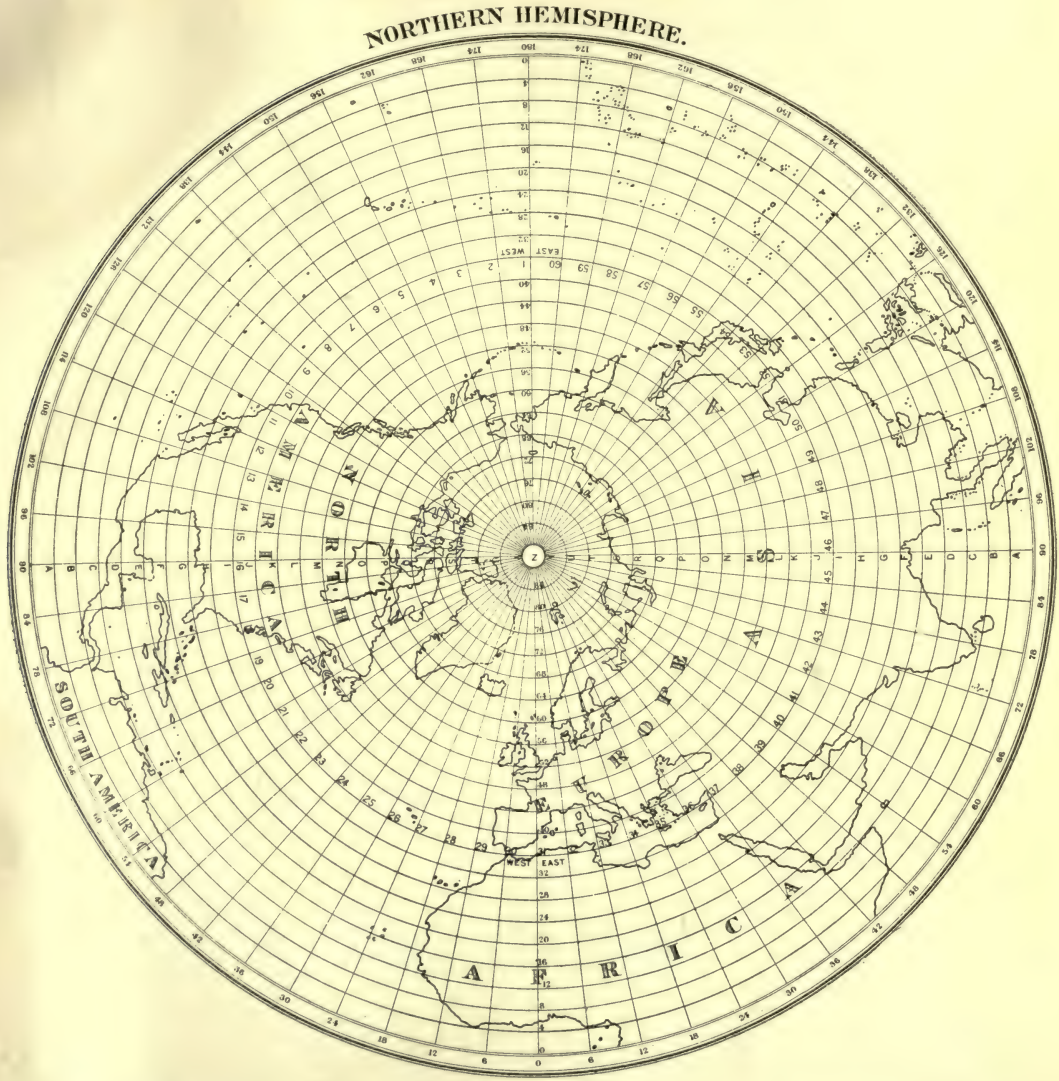


DIAGRAM SHOWING ARRANGEMENT OF SHEETS FOR THE INTERNATIONAL MAP ON THE SCALE OF 1 : 1,000,000

number. The United States Geological Survey now has in course of preparation nine of these sheets, covering parts of the Eastern, Central, and Western States. The originals are being drawn on a scale of one-five-hundred-thousandth, or 8 miles to the inch, and in such a manner that they may be reproduced by photolithography in a clear and effective manner for publication on a scale of 10 miles to the inch. In this form the maps may become immediately available for use by the departments of the government or by individual states; and eventually, as Congress provides the means, they will be engraved and published on the scale of one million (16 miles to the inch), with all the details

required by the decisions of the international conference at London. It may be assumed that they will then be available to any one at the cost of paper and printing, as is now the case with the topographic atlas sheets prepared under the same auspices.

ALL GOVERNMENTS UNITE TO COMPLETE THE MAP

The unanimous conclusions of the London conference have pledged the great powers to the standard map of the world, which Professor Penck proposed eighteen years ago. The need of that map is greatest concerning the countries which have been least adequately mapped, and among these we must count both Americas, as well as Africa, Asia, and Australia. Good maps exist of all of Europe, ranging in scale all the way from one to twenty thousand up to one to one and a half millions.

For Europe the data are all available, and the preparation of the one-millionth map is a question of a contract between some one of the great publishing houses of England, France, or Germany and the governments that are interested. It was understood at the conference that the work would thus be committed to one establishment, so far as Europe was concerned, in order that uniformity might be secured.

But the United States government is gathering the original data for the mother maps of this country, and is compiling and publishing them at a cost much below that which a European publisher would necessarily charge. It therefore, through its delegates at London, declined to send the original data to Europe, and reserved to itself the preparation of these original maps. It is to be hoped that the task may be prosecuted with energy, and that the first edition of the one-millionth map of the United States as a part of the standard map of the world may be engraved and published within ten years.

This compilation will then represent the state of knowledge at the time of completion of each sheet. As surveys progress, corrections and additions will be necessary, and the progress of improvement in the map will become an index to the progress of civilization in our country.

THE LAND OF THE CROSSBOW

By George Forrest

THE journey here described was made with the object of exploring botanically and geographically that portion of the Salwin Valley lying between 26° and 27° 30′ north (for map see page 147).

The tract of country between the parallels mentioned was "terra incognita," and had been persistently shunned by all, Chinese and Europeans alike, as inhospitable, barren, and unnegotiable; certainly, as will be found hereafter, we found it so, but despite these disadvantages it had one point of absorbing interest. Here in this region, comprising the whole of the basin of the Salwin, was supposed to be the home of the Lissoo race; from that point the offshoots spread northeast, east, and south over practically the whole of the province of Yunnan and parts of northwestern Szechuan.

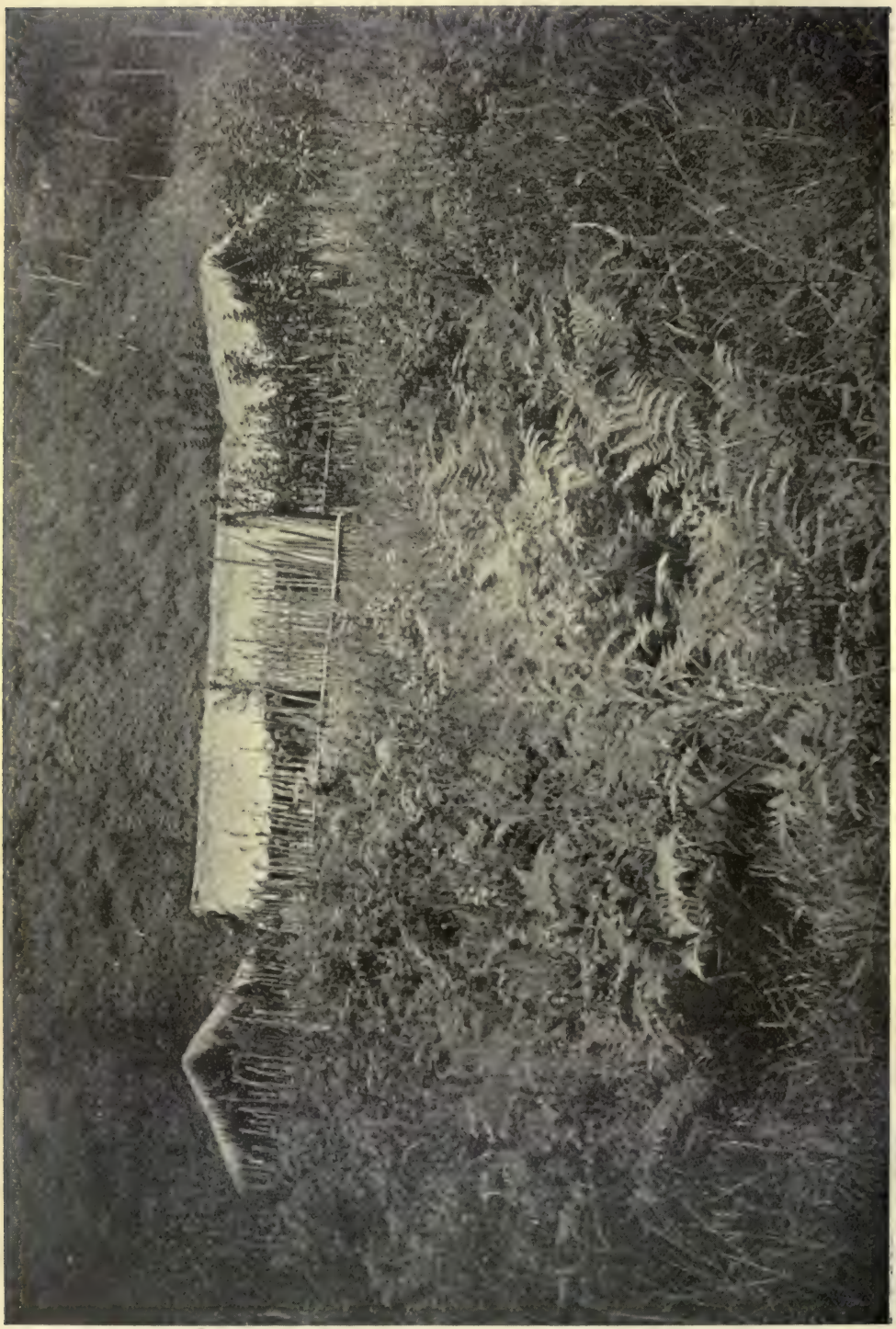
Starting from Teng-yueh-ting in perfect weather, we traveled due north, and on the fourth day passed the last Chinese village and entered the country of the Lissoo, camping near the hamlet of Ta-chu-pa. This, in keeping with most of the Lissoo villages, was only a miserable collection of a half dozen rain-sodden huts, thatched with coarse grass, and with eaves so low that to enter one

THREE LISSOO GIRLS OF TA-CHU-PA

had to bend almost double. It was, however, unique in being surrounded by a stockade of alder logs, most of which had taken root, forming a dense hedge. Probably the reason of this unusual possession was the position it held, being situated at the base of one of the passes leading over the divide into Burmese territory, and therefore liable to raids by the natives of that region.

The head-man of Ta-chu-pa soon found us a sufficient number of men to act as porters, and a day was spent apportioning loads to be carried on the back, consisting of a reserve supply of rice, done up in rawhide bags—a most important item in the baggage, as we could not count on buying food of any description or in any quantity in the country to the north of us. A Lissoo can carry on his back for full stages of 6 to 8 hours, in difficult and mountainous country, about 70 pounds weight, but he daily consumes 1 pound 7 ounces of dry rice.

All preparations for a move forward having been made, our bad luck began. The southwest monsoon returned, and for twelve days an almost continuous



THE LISSOO VILLAGE OF TA-CHU-PA: ALTITUDE, 7,000 FEET

deluge ensued. Camped as we were in the open, surrounded on every side by dense bracken and grass, averaging 4 to 5 feet in height, we were soon in the depths of misery. Even with improvised shelters over them it was with the greatest difficulty we could keep our fires alight. We did resort to the huts, but, with the number of our men added to the inhabitants, the accommodation was so taxed, the smoke of the fires—for which in the heavy state of the atmosphere there was little or no escape—so acrid, and the stench of steaming, vile humans so offensive, that eventually we were glad to return to the cold, damp comfort of our tents.

The weather having become more settled, we crossed the Irrawadi-Salwin divide by the lonely but beautiful Pienma Pass, 10,500 feet, and descended the Ku-tan River, a small tributary of the Salwin. From the village of Ku-tan we turned north, and on October 30 (1906) reached the village of Lu-chang, the residence of a semi-Lissoo chief, where Mr Litton had camped during his previous journey. The village is in a fine and healthy situation, some 3,000 feet above the river, and the people most friendly. The chief, who is a boy of 10 years of age, came to call on us, and a number of men offered their services as porters.

A DIFFICULT TRAIL

From Lu-chang we sent back the baggage animals and proceeded on foot for three marches northward—32 miles by the track, but scarcely 14 in direct line—and here the difficult nature of the country was first thrust upon us.

To travel continuously at the level of the Salwin, or even 1,000 feet above it, means fever in a very short time for native or European, and that even during the dry season; to be completely out of the danger zone one has to be from 2,000 to 3,000 feet above the river. The surface of both flanks of the valley is corrugated with huge spurs, intersected by deep and precipitous ravines, and the tracks, such as they are, lead up and down over a series of these ridges, which descend right from the tops of the divides to the Salwin.

To negotiate them is a trial of strength to the traveler's legs. Thus, starting from Lu-chang, at 6,400 feet, there is a steep drop of 3,300 feet to the Salwin in 4 miles; then follows an ascent of 4,000 feet through grass and pine forests to the top of the next ridge, 800 feet above the scattered village of Mao-chao—14 miles from Lu-chang—which, like Lu-chang, among its log and bamboo huts boasts one tiled house, the so-called yamen, the residence of the hereditary native chief. From Mao-chao there is a rough track which, after some steep ups and downs, plunges 1,500 feet into a tropical jungle of palms and lianes, through which runs one of the numerous mountain torrents which are the only tributaries of the upper Salwin. Then a precipitous climb of 900 feet through cultivated patches leads to the ridge of Shih-pai-li-ti, 6,700 feet and 10 miles from Mao-chao. Between Shih-pai-li-ti and Pei-pa (8 miles) there is an even steeper gully, the bottom of which is 2,000 feet below the level of the ridges.

The above gives only a faint conception of the difficulties negotiated. Later on, where there was practically no communication between the villages, we had to make our own tracks, and it was no uncommon thing for us on rising in the morning to have distinctly in view, only a mile or two distant, the site of the following night's camp, invariably reached only after a long day's exhaustive toil.

In all this country the villages are scattered along the opener sections of the ridge tops or on natural terraces in the mountains at from 5,000 to 7,000 feet. Above 7,000 feet to the top of the divide the country is too steep and rocky and the forest too dense to admit of villages or cultivation; below 5,000 feet the country is too malarious, but every village has its patch of rice-fields 2,000 to 3,000 feet below it by the banks of the Salwin, whither the inhabitants descend to sow and reap much as they did in the time

of Marco Polo. This obtains as far north as the village of Hsia-ku-dè; beyond that nothing but maize, which is the staple food of the people, is grown.

PROFUSE ORNAMENTS WORN BY THE WOMEN

The people are all Lissoo, with a strong admixture of Chinese blood. The men mostly dress in Chinese fashion, but the women, while adopting the Chinese cotton cloth, retain the petticoat and profuse decoration of head, with armlets, bracelets, and necklets, which is so characteristic of the true Lissoo garb. I have seen young girls with ornaments which in the aggregate must have weighed 15 to 20 pounds. It made one positively weary to look at some of them. The necklaces generally consist of discs of polished bone 1 to 1½ inches in diameter, cowry shells, which are said to be imported from Tibet—at any rate, they filter down stream from the north—variously shaped pieces of silver and water-worn pieces of a poor quality of turquoise which is found in the valley. In addition to these there are generally several strings of large blue beads, which, I understand, are brought over as barter from the Mekong Valley by a few Minchia traders who are daring enough to risk their all dealing with those people. The bangles and armlets are mostly of pure silver, very rarely copper is seen, and in this manner most of the girls carry their dowry about with them.

Few of the people can speak any Chinese except the chiefs and their families. They hardly go beyond their own villages and seem to live happy, quiet lives, only disturbed by the occasional difficulty of obtaining food and by the trouble and petty exactions which attend the work of collecting the chiefs' tribute, or house-tax, of half a tael (= 1 shilling 4 pence) per annum. The usually peaceable condition of this portion of the valley is no doubt due partly to the general absence of interference by the Chinese mandarins, which is owing to the fact that the country is too poor to be worth squeezing. The chiefs have none of the machinery and exercise none of the functions of a regular government, except collecting their dues, in which they are assisted by a Chinese clerk. Each village seems to regulate its own affairs through its headman.

A PECULIAR RIVER

In this section of its course the Salwin at low water varies from 90 to 130 yards in breadth and in most parts is of great depth. There are no falls, but numerous rapids, at some of which the river is contracted to less than 80 yards. The volume of water in the rains is enormous; we found unmistakable signs of the river having risen, in August, over 40 feet above its November level. In the fine season the water is intensely cold. The river is here confined, not indeed between precipices, as was supposed, but between a series of steep ridges, falling down in endless succession from the Mekong and Irrawadi divides. In many places these ridges have a final sheer drop to the river of 500 to 1,000 feet, so steep indeed that, even if climatic conditions allowed of traveling at water level, it would be found impossible to circumvent their bases.

The upper Salwin is quite free from the great bends which characterize the Yangtze; it also receives no tributary beyond a few mountain torrents, the reason of this being, of course, the extreme narrowness of the Salwin basin. At latitude 26° 30′ north an airline of 18 miles would join the east and west limits of the basin, while in latitude 26° 50′ north a line of 40 miles would span it and also the basin of the Mekong.

North of Luchang, on the west or Irrawadi side of the Salwin, the mountains are exceedingly precipitous, and come down in a series of fantastic, jagged ridges, divided by deep gutters. Altogether our advance up the river was slow in the extreme; even the river banks at the few places where we risked following them were encumbered by enormous boulders, piled together like Pelion upon Ossa, rendering progress most difficult.

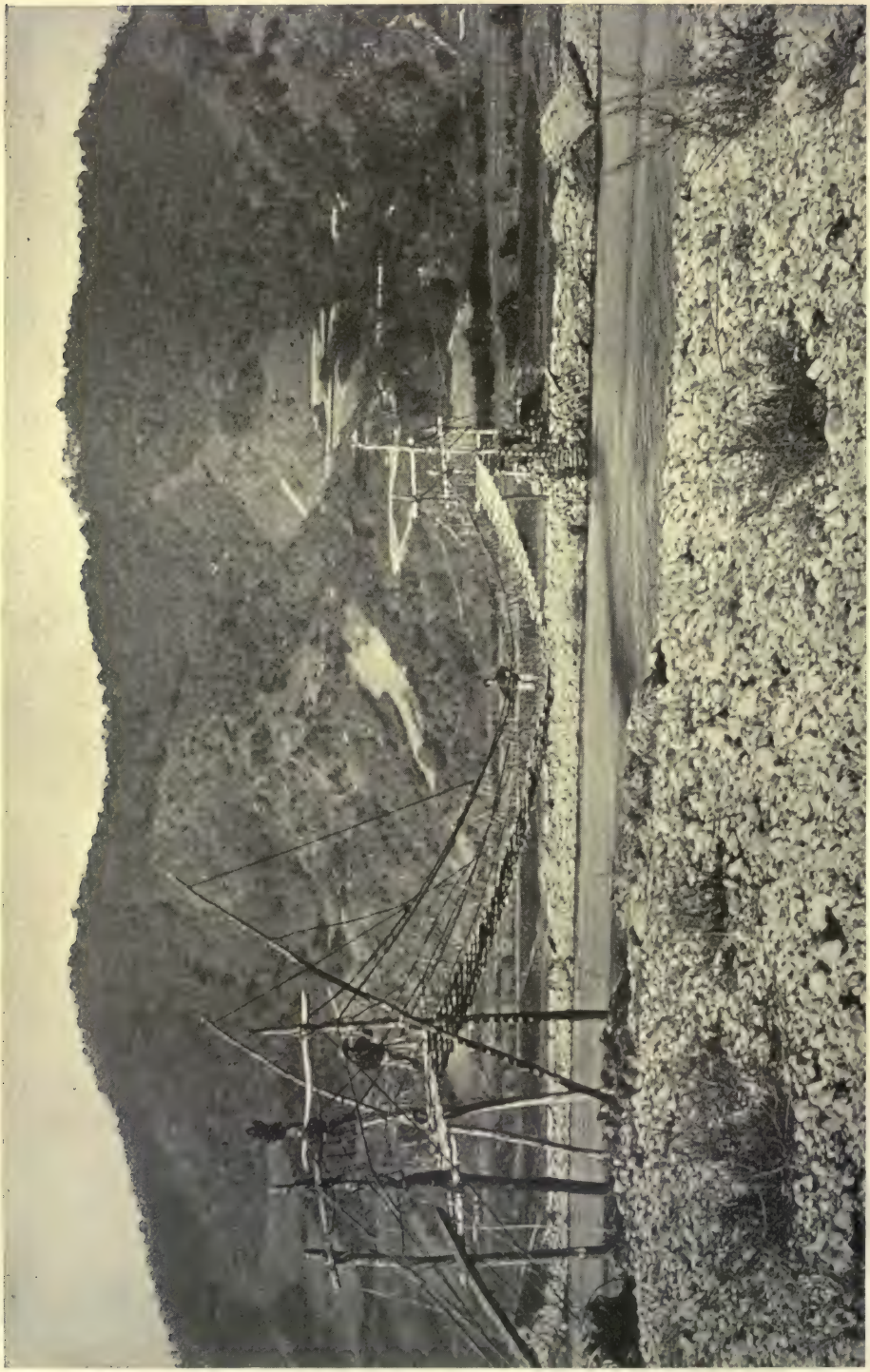
GROUP OF LISSOO NATIVES: TA-CHU-PA

The basis of the rock formation of the Salwin is limestone and the strata of the higher slopes are tipped up so as to point to the sky.

FEW BIRDS BUT MANY TROUBLESOME INSECTS

Animal and bird life along the Upper Salwin is conspicuous by its absence—an important matter for the traveler, who cannot count on replenishing his larder with game. On the other hand, the river banks at a low altitude, and where wholly sheltered from the northwest winds, have an almost tropical climate, and as the result vegetable and insect life is both vigorous and troublesome. Creatures with inconveniently long legs plunge suddenly into one's soup, great caterpillars in splendid but poisonous uniforms of long and gaily-colored hairs arrive in one's blankets with the business-like air of a guest who means to stay. Ladybirds and other specimens of coleoptera drop off the jungle down one's neck, while other undesirables insert themselves under one's nether garments.

The light in the tents attracts a perfect army of creatures, which creep, fly, crawl, buzz, and sting. Scissor insects make the day hideous with their strident call, and the proximity of Lissoo coolies introduces other strangers, of which *Pulex irritans* is by far the least noxious. The mere act of walking in this country is a work of much physical exertion. The villages under the Chinese chiefs have a laudable custom of cutting out their roads every year after securing their harvest, but in the country north of Cheng-ka constant feuds between neighboring villages prevent this useful work; the paths are narrow tracks choked with the luxuriant growth of the previous rains, slippery and lop-sided, and as often as not leading along the very brink of a precipice. In some places we had to haul ourselves over boulders by pendant branches or scramble along the face of cliffs by notches in the rock, work suitable for



SUSPENSION BRIDGE WITH SPAN OF ABOUT 125 FEET, CONSTRUCTED OF LIANA CANE AND SAPLINGS: NEAR TA-CHU-PA

monkeys, Lissoo, or other creatures gifted with more prehensile feet than a European.

MAGNIFICENT SCENERY

Poisonous-looking scarlet fruits hang from the overarching jungle, lianes and tree-roots trip up the unwary traveler; if he clutches the nearest plant to save himself the chances are it is a stinging nettle of the size of a laurel and poisonous in proportion. In some places especially around their maize fields, the natives provide a further diversion in the shape of "pan-ji." These are sharp-pointed, fire-hardened pieces of bamboo, which are driven into the ground among the grass, and will, if trodden upon, pierce even through a leather boot and deep into the foot. It is only when the traveler, scratched, bruised, and with torn clothing, emerges on a quiet sand bank by the river, or on to some open terrace high above it, and finds the campfire lighted, the tents pitched, and a pailful of hot water ready for a bath, that he begins to think exploring the Salwin a game worth the candle.

The vegetation in that part of the country is almost as great a nuisance as the insects. Every sort of seed attaches itself to one's person; some are provided with hooks, others with natural gum, others pierce the skin or work down under one's socks. An hour's march leaves the traveler caked with the seeds of enough plants to form the material of a work on the methods of the natural dispersal of flora.

But the scenery of the Upper Salwin can never be forgotten by any one who has wondered at it in the rich sunshine which prevails after the autumn rains have given way to the first touch of winter. The great variety of rock formation, the abundant forests and vegetation, and the diversity of light effects between the summits of the ranges at 10,000 to 13,000 feet and the abyss in which the river flows produce a vast panorama of ever-changing beauty. In the morning the sun, as it touches the top of the Mekong divide, sends wide shafts of turquoise light down the side gullies to the river, which seems to be transformed into silver. The pines along the tops of the ridges stand out as if limned by the hand of a Japanese artist. In the evening all the wide slopes of the Mekong side are flooded with red and orange lights which defy description or photography and would be the despair of even a Turner. The traveler whose fortune it has been to explore the great rivers of this our northeast Indian frontier will admit that the Salwin, while it is inhospitable, difficult, and barbarous, far excels in natural beauty all the valleys of the sister rivers, the Yangtze, the Mekong, and the Irrawadi.

OUR FIRST MEETING WITH THE CROSSBOW

Continuing our march from the sand bank below No-li-ka, 7 miles from Pei-pa, we toiled up a steep slope to the terrace and village of Shih-chi-di, 1,500 feet above the river; here we had a good reception from the Lissoo, deputations from several villages round offering us small presents of eggs and rice. From this point northward the people were clad in the Lissoo style, and few or none could speak Chinese.

On clearing the top of a ridge we found ourselves confronted by a number of warriors with huge crossbows, headed by the local "ni pa" (prophet or medicine man). He produced a paper scrawled over with rude imitations of Chinese characters, and declared he had received instructions from heaven to go and kill somebody, and that he thought the headman of Cheng-ka was the most suitable person, but he desired our advice. We strongly recommended him to go home and see to the grinding of his maize crop.

All along the road we met a number of warriors hastening to follow the prophet to Cheng-ka, but they were far from wishing to molest us; indeed, several of them left the warpath to escort us on our way, and, after seeing a twelve-shot repeating Winchester rifle fired, desired our alliance and assistance in the projected raid on Cheng-ka.

After leaving our bellicose friends we crossed another gully to Hsia-ku-dé, a

A LISSOO OF THE SALWIN VALLEY

large village for this country, consisting of some 40 houses of the true Lissoo type, constructed of rough logs and bamboo matting, raised on piles, with one room only and a tumble-down verandah. A stone hearth occupies the center of the room, and around this the family eat and sleep. The head-man was a typical old Lissoo, tall and thin, with a close-shaven gray head, bleary eyes, an aquiline nose, huge earrings of silver and cornelian, and a profusion of bracelets and beads hung about his person and over his dirty hempen clothes.

SINGLE-ROPE BRIDGES

It was near here that we first saw a single rope bridge across the Salwin. These single-rope bridges of the Upper Salwin are far more difficult to cross than the double ropes of the Mekong, by which the passenger always starts from a higher level than that at which he lands on the other side, and is thus rapidly car-

A GROUP OF LISSOO OF THE VILLAGE OF LO-MA-DI (SEE PAGE 145)

ried across by his own weight and with little or no exertion. On a single-rope bridge, however, after having been trussed by cords onto a runner, it is necessary to haul one's self across hand over hand; as one is tied with face to the sky and back to the water, this is a difficult operation. As the Salwin ropes are made of very roughly twisted cane, there is always the chance that the whole affair will break in the middle, and the certainty in any case that one will arrive on the opposite side with hands full of painful splinters off the rope.

After leaving Hsia-ku-dé we found that the country increased in wildness with every march, and the inhabitants in squalor, poverty, and barbarism. Every village which we passed gave us terrifying accounts of the ferocity and savagery of the next, where we should infallibly have our throats cut, etc. On the Lower Salwin we had heard stories of people on the upper river who never attempted to

LISSOO WARRIORS OF THE SALWIN VALLEY

The arrow shot by the crossbow is poisoned, and travels with such speed that it will pierce a deal board an inch thick at 70 yards (see page 155)

LISSOO WARRIORS ARMED WITH THE CROSSBOW (SEE PAGES 146 AND 155)

A BRIDGE OF CANE AND LIANAS ACROSS A TRIBUTARY OF THE SALWIN IN THE LAND OF THE CROSSBOW

wash and who smeared their faces with grease and filth; this was perfectly true of the inhabitants we were now meeting.

The food question, however, was the most difficult for us to solve, and on November 9 we stopped at the considerable village of La-tou-wa-dé (4,500 feet) to endeavor to raise supplies. Here all the people, men, women, and children, were dressed in hempen garments of pure Lissoo style; none of them spoke a word of Chinese or acknowledged any sort of Chinese or other authority. They had not even a head-man of their own. They were, however, willing to trade, and suggested that Mr Litton and I should barter our breeches for a bag of rice, but, as we had only one pair in serviceable condition, we could not accede; but a Chinese coolie who was with us did a deal with one of his ragged and lousy jackets, which he bartered for some maize and salt.

Cloth was the object in greatest demand, but unluckily we had none to spare; therefore one skinny chicken, a few pounds of bad rice and maize, and two bamboo tubes full of honey were all we could get from this village of thirty houses, and even this purchase upset the local market.

Beyond La-tou-wa-dé the country became wilder at every step. We were able to do a good long march of 11 miles, mostly along the river, here broken by many rapids and under beetling cliffs, to an opening in the mountains, where, above some padi patches, is situated the picturesque village of Chong-wa. The few inhabitants fled at our approach, but we captured one, and through kindness shown to him managed eventually to coax some of the bolder spirits back to our camp. We found they had feuds with all their neighbors, and were afraid to guide us a mile in any direction, unless we were anxious to attempt a little-frequented pass which, they declared, led up from their village in three days' march to some friendly Lissoo villages on the other side of the Irrawadi divide. Our chief object, however, was to reach a point farther north, whence it would be possible to get an extensive view up the Salwin, and thus discover the general geographical features of the country.

WHERE FIREARMS WERE UNKNOWN

Learning of the existence of a rope bridge across the Salwin a few miles farther on, we decided to cross the whole party to the other side, where, we were told, the villages were larger and more civilized, and that there were passes eastward over to the Mekong. Luckily we found a native of the important village of Lo-ma-di, on the left bank, returning home from the right bank, and he at once volunteered, in consideration of a bead necklace, to fetch his comrades with the ropes and runners necessary for crossing our party, which consisted in all of 35 persons and a dog.

Meanwhile the people of the village on the right bank, where we were camped, had heard of our arrival, and came down to see us, and a wild lot they were. It then appeared there was a feud about this rope bridge between the two villages on the right and left banks respectively, each party claiming that the right and profit of assisting travelers across belonged to them alone. We offered to give an equal present to both parties, but when our friends from the left bank returned with the runners we saw at once we were in for a serious disturbance. The right-bank party was led by a bullying savage, who shouted that the left-bank party should not help us across. The lefts had rashly left their weapons on the other side, but proceeded to tie up one of our loads for the passage; whereupon the leader of the rights whipped out a poisoned arrow, ran back along the path several paces, fitted it in his bow, and shot it over our heads into the river—a sign, like Mr Snodgrass taking off his coat, that he was about to begin.

As we were all crowded on a narrow path, near a tree to which the end of the rope bridge was secured, and the bellicose Lissoo was about to draw his bow again with an arrow in it which might find a billet in the body of any of us, the situation was critical. Mr Lilton and I at once rushed him, and I fired several

shots from my Winchester repeater over his head at a boulder on the other side of the river. The effect of seeing the bullets smash against the stone at such a distance was immediate, and then, through our interpreters, we told the man and his friends that if they made a show of stringing their bows again the next bullet would find a resting-place in some of their carcasses. They had little, if any, idea of firearms, and they at once subsided into an awe-struck silence; but still we had to stand on guard, and at intervals give exhibitions of our marksmanship and the power of our weapons, till all our party had been safely hauled across the rope to a sand bank on the opposite side, where we pitched camp, together with our friends from Lo-ma-di, who expatiated on the savagery of the low people who lived on the right bank, congratulated us on the manner in which they had been suppressed, and promised us a hearty reception at their own village next day.

Early the next morning we ascended steeply from the river through carefully cultivated patches of maize, millet, and buckwheat to 6,500 feet, when we came in sight of Lo-ma-di. Our friends of the previous day and a number of their friends were now with us, and, though all armed to the teeth, were most amiable and childishly delighted with our firearms, our clothes, and the pointer dog.

What was most interesting to us was an extensive view we obtained from that point looking straight north up the funnel-like valley of the Salwin. As far as the eye could reach we could trace the almost direct north-and-south course of the river, and the succession of ridges falling down from the high ranges to the river from the east and west divides in a manner so regular as to suggest the ribs of a huge skeleton.

We found Lo-ma-di the largest, cleanest, and best built Lissoo village we had yet seen: some 90 households were scattered along a broad slope at an altitude of 6,500 feet, looking down on the Salwin more than 2,000 feet below. Groves of pine and fruit trees gave grateful shade, and the small garden plots were divided by neat bamboo fences. The picturesque inhabitants, with their beads, cowries, silver ornaments, and long hempen garments, came out *en masse* to welcome us, and several of the village elders brought trays of rice, eggs, vegetables, etc., which they offered on their knees. We met several Chinese-Minchia traders from the Mekong; they bring cotton cloth, opium, salt, and goats, which they exchange for local produce, the staple being a varnish produced by tapping a varnish tree similar to one which is known in the province of Kwei-chou. Beeswax, some drugs, and a small supply of gold dust are also exchanged. Trade with the Lissoo, we were told, is a profitable but risky matter, as there is no sort of government in the country, and even the comparatively civilized tribes on the left bank of the Salwin are continuously fighting among themselves.

The attentions of the Lo-ma-di crowd became so embarrassing that we resolved to push on into the mountains. Marching southeast by an excellent path through oak scrub, we halted for the midday meal at the hamlet of Ji-Ji, situated at 7,200 feet on an open, wide ridge commanding extensive views down the mountain ranges to the south.

AN ARMY CORPS OF CROSSBOW WARRIORS

The men of Ji-Ji were at war with the people of a neighboring village higher up the hill, and we had the pleasure of watching the progress of the fight during our tiffin. The cause of the trouble was the theft of some maize, and a whole army corps, consisting of some fifty warriors, had been mobilized. These fellows, with their grotesque ornaments of silver, deers' horns, pebbles and cowries, their blackened faces, their flowing hempen robes, their war-bows 5 feet broad, their war-swords 5 feet long, and their broad ox-hide shields 5 feet high, moving in a line beyond their village, presented an image of the "pomp and pride and circumstance" of war. The enemy occupied a position higher up the hill and a fierce bombardment of oppro-

99°
27°
Lo-ma-di
Mekong Riv.
Lu-po
Yako Peak
9400
Shih-chi-di
No-li-ka
Cheng-ka
Salwin
Pien-ma
Pass 10500
Lu-chang
Teng-kong
Shweli Riv.
Sketch Map of
THE UPPER SALWIN
10 5 0 10 MILES
TENG-YUEH-TING
(MOMEIN)
BRAHMAPUTRA R.
CHINA
BURMA
MANDALAY
RANGOON
Salwin Riv.
0 50 100 200 MILES

brious epithets was maintained, but neither side got farther than swearing and stringing bows until the time arrived for the afternoon meal, when the combatants dispersed to their respective homes.

Ji-Ji was the last village on the path leading up to the Mekong-Salwin divide, which we now determined to cross. On the evening of November 13 we made good way into the mountains, marching along an easy but narrow path through woods high above a feeder of the Salwin. Camp was pitched 4 miles from the river, under a large rock overhanging the path, which gave the men some shelter from the damp of the forest, and early next day we negotiated the pass.

Crossing the head of the stream, above which we had marched the day before, a long and steep but not difficult ascent through bamboo and pines brought us out on an open alp at 10,500 feet. Hence a climb by a rocky path took us up on to a bare, wind-swept col which forms the pass at 12,500 feet, 20 miles from the Salwin.

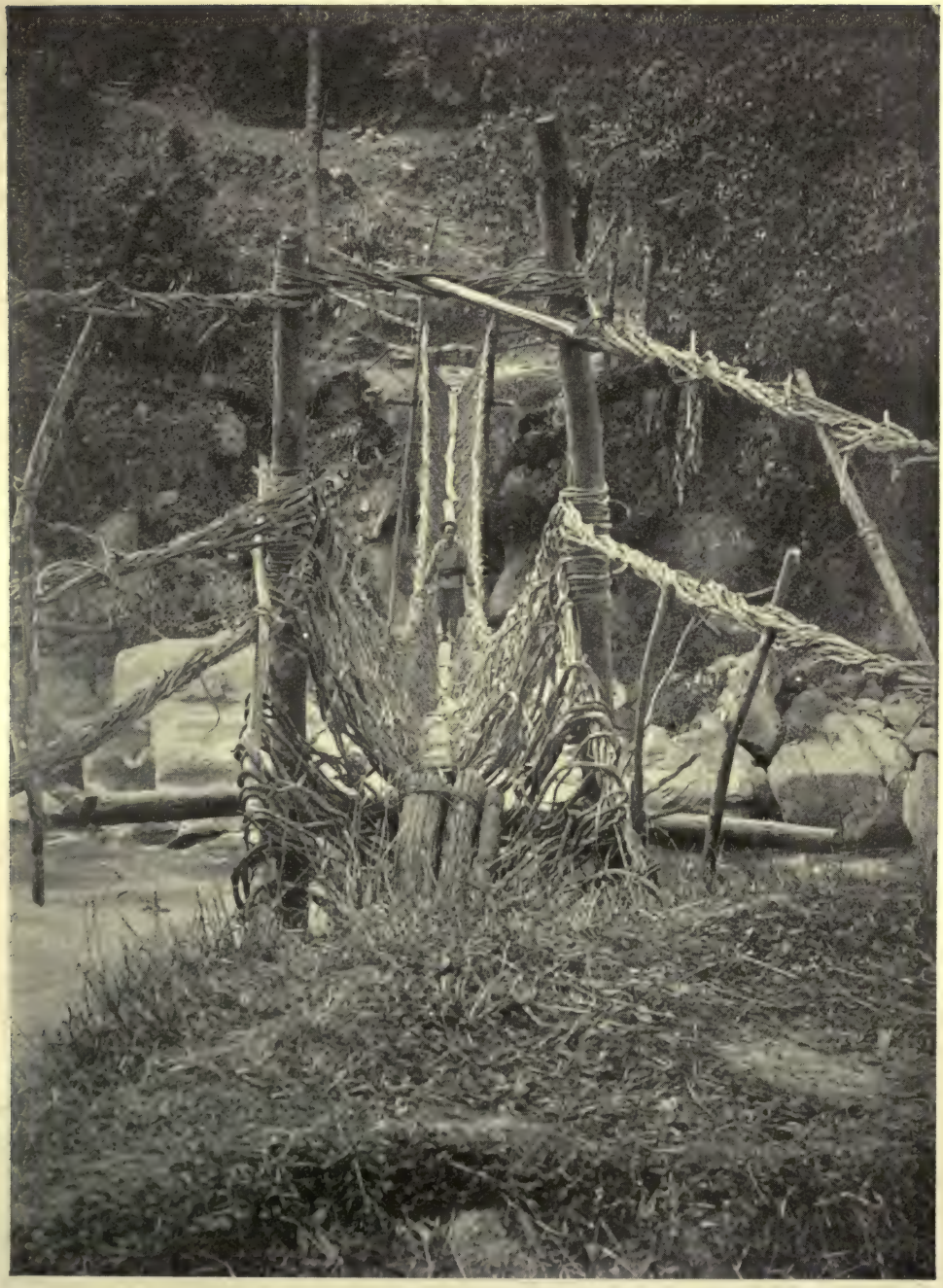
Unluckily mist was being blown along the ridge and this obscured our view, but several bare limestone peaks were seen, rising 1,000 to 2,000 feet above the pass. The men were all benumbed by the intense cold, and at the first sheltered spot, some 500 feet below the summit, we lit a roaring fire of bamboos and enjoyed, so far as the mist allowed us, an immense view of the Lichiang and Tali prefectures beyond the Mekong. In the afternoon we got on to a convenient but steep spur and made rapid progress down toward the Mekong; we camped in a wood at 9,400 feet after a march of 15 miles. We were over 5,000 feet above the Mekong and some 20 to 25 miles north of the Chinese market of Ying-pan, situate on the left or east bank of the river. This is a salt bazaar and the center for all the petty trade between the Minchia inhabitants of the Mekong and the wild Lissoo, and there we intended to replenish our exhausted commissariat.

Turning south we found an excellent high-level road, by which, on the afternoon of November 16, after a 25-mile march, we reached the mud-built Minchia village of Pu-mu-tou, 7,500 feet altitude, from which Ying-pan bazaar could be seen dimly across the river far below us.

The people of Pu-mu-tou, at first apprehensive that we had something to do with the Yamen, soon became friendly, and brought fowls, eggs, and a pig for sale. Also some of our men were sent down to the market next day and returned laden with supplies; therefore we were again in a position to face the terrors of the foodless Salwin, and the headman of Pu-mu-tou volunteered to guide us up to the divide by a different pass from that by which we had come on condition that we would not expect him to approach any of the villages of those "terrible, wild Lissoo."

This part of the Mekong differs widely from the Salwin valley in the same latitude. Instead of sharp crags and cliffs of limestone, dense semi-tropical jungles, extensive forests, and wild Lissoos with their poisoned arrows, we viewed a peaceful scene of wide, bare, cultivated slopes of clay or disintegrated sandstone, shelving down in terraces to the river below. The basin of the Mekong at this point is twice the breadth of the Salwin, though the altitude of the latter river is 1,000 feet less. The people, like the scenery, are altogether less wild than on the Salwin. The houses of mud brick are built into village streets, instead of being scattered about over the hillside. Large villages of 50 to 100 houses occupy all the good sites where water is available for rice irrigation.

In customs, dress, mode of life—in fact, in everything but in language and race—these people are, to all intents and purposes, Chinese. They are too far off from their "father and mother," the Lichiang official, to be troubled much by Yamen underlings, Lichiang being distant eight long mountain stages. They live, if not a strenuous, at least a peaceful and not unprosperous life, and, being far more industrious in cultivation and



ANOTHER TYPE OF LIANA BRIDGE IN THE LAND OF THE CROSSBOW, SHOWING APPROACHES AND FASTENINGS

SINGLE-ROPE BRIDGE, OWNED BY THE VILLAGERS OF LO-MA-DI, SHOWING A NATIVE IN THE ACT OF CROSSING: SPAN FULLY 300 FEET (SEE PAGES 140 AND 145)

ONE OF OUR CAMPS IN THE MOUNTAINS AT AN ALTITUDE OF 11,000 FEET, SHOWING THE LICHIANG RANGE

less troubled with clan fights than the Lissoos, are less frequently subject to the ravages of famine.

SUPERB MOUNTAIN RANGES

From Pu-mu-tou we ascended a spur through oak scrub and over grassy slopes, rising in the day's march from 7,400 to 10,500 feet on the slope toward the Salwin divide. At this altitude there was a superb view of all the great ranges of northwestern Yunnan east of the Mekong from Talifa to the borders of Tibet. Most of those northwestern Yunnan panoramas are dominated by the glittering snow mountain of Lichiang.

After an intensely cold night on the mountain side at 10,500 feet, we proceeded on November 19 up the pass, the summit of which we reached at 12,300 feet altitude. Here a surprise awaited us, for the view to the west was perfectly clear, and the whole of the great Salwin-Irrawadi divide was spread out before us. From a little below the pass this range could be followed to the north as far as the eye could reach, until at a distance of about 100 miles from where we stood, and in approximate latitude 28° 30′ north, it was merged in a huge range of dazzling snow-peaks, trending westward. This range is doubtless the east source of the Irrawadi, and forms the divide between it and the Zayal, the Bramaputra system. The upper slopes of the Salwin-Irrawadi divide resemble a vast wall trending most regularly from north to south, and there are no very conspicuous peaks. The average height of the summits in that latitude, 26° 55′ north, would be probably 12,500 to 13,500 feet. There was practically no snow on it in November.

Below the wall-like ridge forming the backbone of the range, limestone spurs, crags, and precipices in bewildering confusion fall down to the Salwin. It was easy to see why the upper slopes of the

SUSPENSION CHAIN BRIDGE ON THE MEKONG RIVER, ON THE MAIN TRADE ROUTE FROM UPPER BURMA TO YUNNAN
It is formed of 12 iron chains and plank roadway 8 feet wide. Breadth of span, 70 yards

THREE WOMEN OF PU-MU-TOU (SEE PAGE 148)
The central figure has her arms withdrawn from sleeves to within gown

range are uninhabited, and why this mountain barrier is an ethnographical boundary between the Lissoo and Kachin races.

On this pass, as at many other places on our journey, we saw several mouldering skeletons by the sides of the pathways, victims either of the famine of the previous season or of a savage temper and a crossbow. The Lissoo have a superstitious terror of human remains and give them a wide berth. In the afternoon, after crossing the pass, we made good way along the top of a well-defined winding spur which rose up from the Salwin. Descending to 8,600 feet, we camped at the small Lissoo village of Lu-po, from which place the pass derives its name, after a march of 15 miles.

The next day, when, by a break-neck descent on a slippery declivity, we reached the Salwin at 3,700 feet, near the village of U-a-lo, we found that three of its enterprising inhabitants had just made a rude raft of bamboos, loosely tied together, and were prepared to take our party across. As the *ship* could only carry two men and two loads in a journey, and as the Lissoo do not shine as watermen, the crossing was not completed by nightfall. Next morning the crossing was hurried to a finish, as we were becoming seriously alarmed at the inroads fever was making in our little party, exhausted by the labors of a flying march; two very bad cases had to be carried on the backs of two of our coolies, and our stock of drugs was soon exhausted. Luckily we got through without the loss of a single life, and by forced marches returned to our base camp, near Lu-chang, on December 1, in good spirits if in ragged clothes.

SCENE IN TIBETAN FOREST, ON THE EASTERN FLANK OF THE MEKONG-SALWIN DIVIDE: ALTITUDE, 10,500 FEET

REMARKS ON THE LISSOO TRIBE OF THE UPPER SALWIN

The Lissoo race, if not powerful or very numerous, occupies a large tract of territory. The tribe is undoubtedly an offshoot from the southeast of Tibet, probably before the introduction of Buddhism into Tibet. None of the Lissoo, even those who live among or near Tibetans, shows the least trace of Buddhist influence or belief. Their religious practices closely resemble those of the Kachins, who believe in numerous "nats" or spirits which cause various calamities, such as sickness, failure of crops, etc., unless propitiated in the most suitable manner. The most important spirit is the ancestral ghost. Lissoo graves are generally in the fields near the villages; over them is put the cross-bow, rice-bags, and other articles used by the deceased. It is probably from foundations such as these that the fabric of Chinese ancestor worship was constructed. Food is also placed on the grave for many days. The upper part of the structure is a roughly hewn board, of the shape but larger than a coffin-lid, to protect the articles hanging on the upright post from the weather.

The Lissoo may be said to form practically the whole population of the Salwin Valley from 27° 30′ to 26° north. They have spread in considerable numbers along the mountains between the Shweli and the Irrawadi, and in isolated groups far away down the Burmese frontier and, I am told, into the Shan States.

In parts of Burma, under British rule they have been found readily amenable to civilization and are more docile than the Kachins. But those whom we saw on the upper Salwin were utter savages.

Most of the villages have not even a regular head-man; nearly every village, too, speaks a different dialect, and two Lissoo sepoys from the Burmese frontier below Tengyueh, whom we had with us, could not make themselves understood beyond 26° 30′ north. There are also

a number of tribal subdivisions—a source of constant feuds. The Chinese official theory that the country belongs to the hereditary Minchia chief "Lo," who resides at Tu-wo, latitude 26° 8′ north, on the Mekong, has no foundation whatever; in fact, on the contrary, no sort of official person would dare to go anywhere near the country.

The villages are nearly all at war with one another; few of the people have ever in their lives been more than a day's journey from their own huts; suspicion, rumor, and terror sit enthroned among those limestone ridges. It is almost impossible to get a guide, and quite impossible to get any accurate information about routes, distances, and such details. None of these wild Lissoo ever seem to have asked whence the River Salwin, which occupies so large a place in their lives, comes or whither it goes, or what is at the back of the great ranges which confine their view of the world. The object of each little community seems to be to keep its neighbors at a distance.

The people are also exceedingly lazy. In the spring they do a few day's work in scraping a patch of soil just large enough to yield subsistence, and in planting their maize, the site of the patch being changed yearly. Then in early October they put in a few day's more work getting in their crop and cutting their hemp, or looking after their tobacco patch. All the rest of their lives is spent in eating, sleeping, and squatting round the hearth, varied by a rare expedition to obtain wood for a crossbow, poison for their arrows, or a stock of salt or wild honey. Under these conditions it is not surprising that, in spite of the sparseness of the population and the great extent of land suitable for maize and other cultivation, famine is of frequent occurrence.

WILD HONEY FOR FOOD

Rice is a luxury; coarsely ground maize, buckwheat, and wild honey are the staple food of the people. Where we passed along there were practically no domestic animals or fowls, as they had all been killed during the famine of the previous season. Wild honey as a change is an agreeable sweetmeat, but after a few days constantly partaking of it the European palate rejects it as nauseous and almost disgusting. Our experience extended over a fortnight, during which period our food consisted solely of it and maize. It has escaped the Biblical commentators that one of the principal hardships that John the Baptist must have undergone was his diet of wild honey.

A draughty hut of rickety logs and bamboo matting, consisting of one room 15 to 20 feet in length and 6 to 8 feet in breadth, the whole raised 3 to 4 feet above the ground on piles, and provided with a verandah and a stone hearth in the middle of the floor—such is the true Lissoo hut. The roof is thatched with grass. A large iron pot, a few wooden bins or bamboo baskets to hold grain, and some bamboo tubes to hold water or honey, with occasionally a few rude stools and a rude loom for weaving their hempen garments—such is the furniture which supplies the Lissoo in his simple life.

THE CROSSBOWS ARE VERY POWERFUL

The crossbow is the characteristic weapon of the country and the Lissoo tribe. Every Lissoo with any pretensions possesses at least two of these weapons—one for every-day use in hunting, the other for war. The little children play with miniature crossbows. The men never leave their huts for any purpose without their crossbows; when they go to sleep the "nukung" is hung over their heads, and when they die it is hung over their graves. The largest crossbows have a span of fully 5 feet and require a pull of fully 35 pounds to string them. The bow is made of a species of wild mulberry of great toughness and flexibility; the stock, some 4 feet long in the war bows, is usually of wild plum wood; the string is of plaited hemp and the trigger of bone. The arrow, of 16 to 18 inches, is of split bamboo, about four times the

thickness of an ordinary knitting needle, hardened and pointed; the actual point is bare for a quarter to one-third of an inch, then for fully an inch the arrow is stripped to half its thickness, and on this portion the poison is placed.

The poison used is invariably a decoction extracted from the tubers of a species of aconitum which grows on those ranges at an altitude of 8,000 to 10,000 feet. The poison is mixed with resin or some vegetable gum to the consistency of putty, and is then smeared on the notched point. The "feather" is supplied by a strip of bamboo leaf folded into a triangular form and tied in a notch at the end of the arrow, with the point of the angle outward. The reduction in thickness of the arrow where the poison is placed causes the point to break off in the body of any one whom it strikes, and, as each carries enough poison to kill a horse, a wound is invariably fatal. Free and immediate incision is the usual remedy when wounded on a limb or fleshy part of the body, but at Cheng-ka the uncle of the Lao-wo chief showed us a preparation which resembled opium dross, and which he said was an effective antidote. Its nature and preparation is a secret known only to the prophets. We saw one man at Cheng-ka who had been wounded through the fleshy part of the arm in a fight, and through the use of the remedy had quite recovered, but in its passage the head of the arrow had not broken off.

The marvelous Chinese stories which one hears of the Lissoo have to be taken with a good deal of salt. The Lissoo are not a fighting people, and, with few exceptions, seemed to us to be arrant cowards, but the crossbow and poisoned arrow is certainly a most diabolical weapon. An arrow from a war bow will pierce a deal board an inch thick at 70 to 80 yards; some of my servants were so expert that they could hit a mark 4 inches in diameter repeatedly at 60 to 80 yards. As no one goes anywhere without his crossbow and his bearskin quiver full of those poisoned arrows, and as every village is at feud with every other, mutual suspicion, of a nature to absolutely prevent social intercourse, is inevitable.

In open fight the Lissoo are usually careful to keep at a respectable distance from each other and behind their three-sided ox-hide shields; these protect the whole body, which is still further safeguarded by a heavily-padded cloth belt extending from the breast down to the hips. But if battle is rare, murder and sudden death by ambush in the jungle are common. The Lissoo has all the lack of self-control which marks the savage, and it is so easy to bend down, string a bow, and send an arrow into any one with whom one has a difference. I can recommend any traveler who falls in with a tipsy or bellicose Lissoo with a crossbow to shoot first and argue afterward. The first step in civilizing these people would be to deprive them of their horrible weapons.

The wild Lissoo are much addicted to strong drink; they make a fermented, not a distilled, liquor out of millet or maize, which resembles strong Japanese saké. They are so improvident they habitually use for wine grain which is required for food.

We were able to lift a corner of the curtain which has hidden them hitherto from the outer world, and I think they may in future be safely left to enjoy in obscurity their dirt, their fever, their limestone ridges, their poisoned arrows, and their wild honey.

THE GREAT NATURAL BRIDGES OF UTAH

By Byron Cummings, University of Utah

WE used to be much interested in the descriptions and illustrations in our readers and geographies of the Natural Bridge of Virginia. People travel from all parts of the world to behold this strange natural phenomenon and enjoy the picturesque scenery of the Appalachian Mountains, and feel well paid for their effort. But Utah is the home of really great natural bridges. She astonishes us with not merely one but half a dozen, any one of which surpasses the Virginia structure in grandeur and beauty. The three remarkable bridges—the Edwin, the Carolyn, and the Augusta—which were discovered in Utah several years ago and described in this Magazine,* are now eclipsed by another more marvelous structure in the same State.

Overlying the southeastern part of Utah are the "red beds"—strata of red and yellow sandstone hundreds of feet thick. For the most part this formation rests in a horizontal position; but in places sections lie tipped at an angle of 45 degrees and more, and great faults have occurred. Ages ago this entire region was pushed upward until it checked and cracked in zigzag lines away from the mountains that were formed by the material from beneath being forced upward through the superincumbent sandstone. Thus came into being the La Sals, the Abahos, the Bears Ears, Navajo Mountain, and the many deep canyons radiating from them.

This process of elevation was a gradual one, and, as the waters from the mountains sought a lower level, they took their courses through these irregular cracks and seams, searching for the ocean, which was then not far away. Their rushing currents and surging eddies wore off the sharp corners, sought out the soft places in the yielding sandstone, digging out deep caverns and recesses in the cliffs, and left behind them a series of graceful curves and fantastic forms that amaze and delight the traveler at every turn. As the formation was pushed upward from time to time, these rushing torrents kept on with their work of smoothing, cutting, and filling until they have produced the deep box canyons so prevalent in this section. Sometimes they widen out into small valleys of rich alluvial deposits and again narrow down to a mere slit between huge masses of cliffs.

This elevation and opening of the formation often left a narrow point of the cliff extending outward for rods around which the stream had to make its way as it rushed onward in its course. The constant surging of the waters against this barrier often found a soft place in the sandstone, where it helped to eat out a half-dome-shaped cave. In a few instances, as the waters swirled around the other side of this barrier, they found a similarly soft place opposite the former and ground out a similar half dome on that side. When in the course of time the backs of these two semicircular caves came together, the waters found a shorter course through that opening and quickly enlarged the archway and smoothed off and rounded into graceful curves the sides of the massive buttresses. Thus a bridge was formed and became a mighty span of enduring rock whose foundations and graceful superstructure were laid by the ages.

THE EDWIN BRIDGE

West of the Bears Ears in White Canyon and its tributary, the Armstrong, are three large bridges that have thus been carved out of the sandstone by the forces of nature. A short distance off from the old "Mormon trail" to Dandy crossing, on the Colorado, in Armstrong Canyon, is found the Edwin or Little

* See National Geographic Magazine, vol. xv, p. 368, and vol. xviii, p. 199.

THE EDWIN OR LITTLE BRIDGE: HEIGHT, 108 FEET; SPAN, 194 FEET Photo and copyright by S. M. Young
(SEE ALSO PAGE 166)

bridge. It is a graceful structure, as will be seen from the accompanying illustration, having a span of 194 feet and an elevation of 108 feet. The top of the bridge is 35 feet wide, while the arch in the center is only 10 feet thick. Thus these proportions give an impression of lightness that is very pleasing to the eye. Round about are domes and turrets fashioned by the same forces that produced the graceful lines and curves of the bridge, and nestling in a cave worn in the sunny side of the cliff near one end is a deserted cliff-dwellers' village.

Passing on down Armstrong Canyon about 3 miles, you find your way almost blocked by a projecting cliff that towers above you in amazing proportions. On the right and on the left similar cliffs seem to be elbowing you out of the way. At the right, however, you notice that the barrier has been worn away; but this is many feet above where you now stand and plainly marks the course of a mighty stream that once forced its way among these cliffs.

Continuing on down the bed of the present-day stream, now nearly dry, you find a few rods farther on that you have reached the end of Armstrong Canyon and stand in the shadow of a vast archway which the waters of White Canyon have cut through this barrier that just now seemed to block the course of the Armstrong. This is the Carolyn bridge, a massive archway carved out of the same red sandstone formation and still showing the unfinished work of the artisan in the sharp corners and broken lines of the arch and buttresses. Nature has not yet given the finishing touches to her work, but wind and storm and driving sand will continue to chisel and polish until the lines are all graceful curves, adding greater beauty to this the most massive of the bridges.

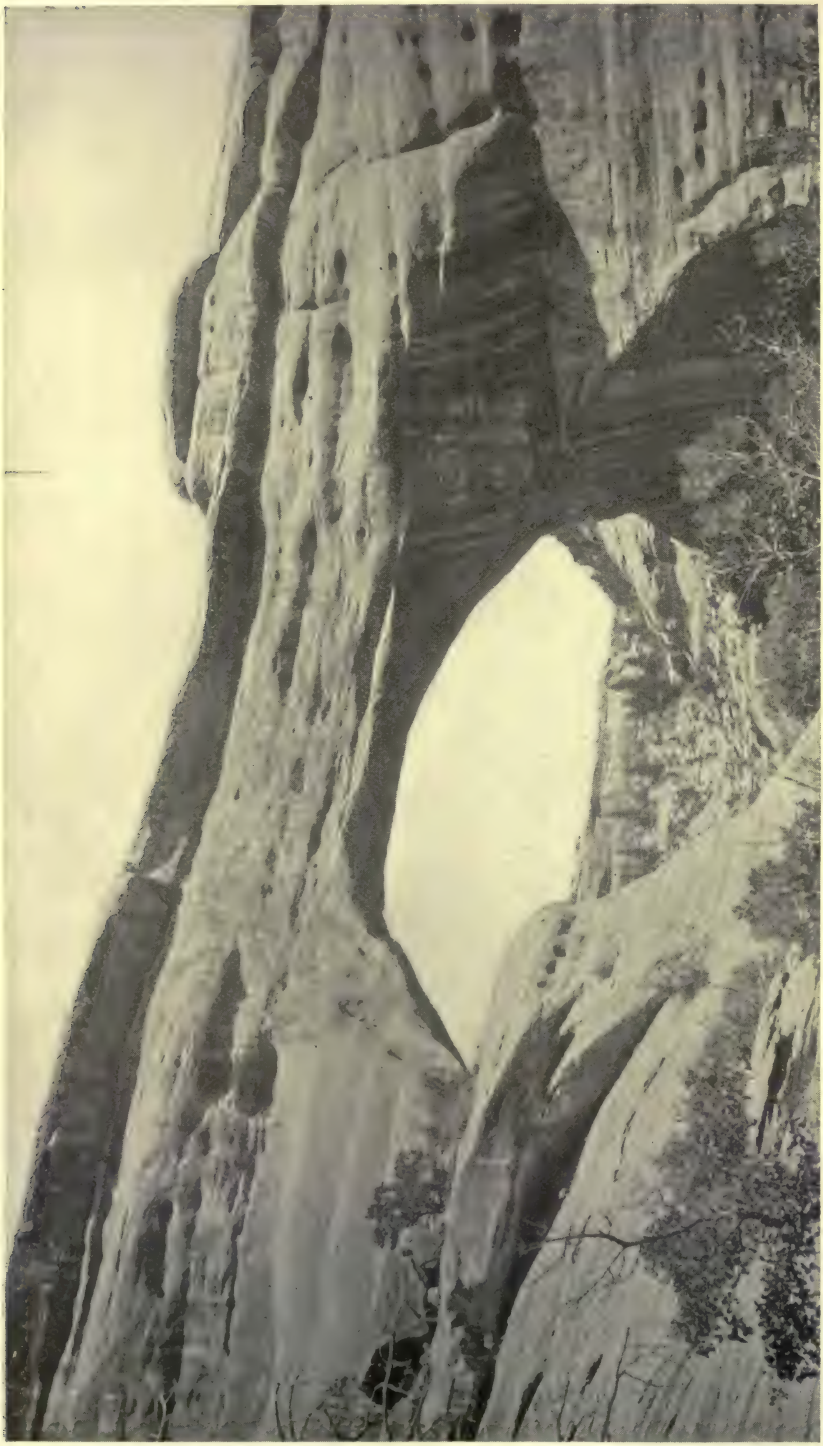
The span is 186 feet wide and from the top of the bridge to the bottom of the gorge is 205 feet. The roadway is 49 feet wide and the arch 107 feet thick in the narrowest part, giving such an impression of massive strength and solidity that one marvels at the mighty power of nature's work.

THE AUGUSTA BRIDGE

Turning to the right underneath this arch and passing up White Canyon, winding in and out between lofty cliffs that send out their towers and battlements, and in the hollows of whose seamed and scarred sides are seen the abandoned homes, fortifications, and granaries of an ancient population, after a walk of 2½ miles you stand under the arch of another of nature's wonders, known as the Augusta bridge. It rises before you in graceful proportions 222 feet high and 261 feet between the abutments. The majestic arch is exceedingly regular, entirely spans the canyon, and you can hardly realize that it has not been designedly placed there as a bridge. The thickness of the stone arch is 65 feet and the roadway is 28 feet wide.

The Augusta, therefore, is the queen of the White Canyon bridges. It combines massiveness with gracefulness of proportions to an extent that gives an altogether pleasing and satisfying effect. Sitting within its shadow and gazing up at the mighty arch curving above, you wonder how many ages it has taken to fashion such a magnificent piece of work. You climb to the cliff above and watch the play of sunshine and shades upon the rich reds and light browns of the sandstone that forms its arch and buttresses and comprehend the gracefulness of its outlines and proportions as a whole, and you seem unable to tear yourself away from the spell of its might and beauty. You feel you would like to take up your abode in one of the ancient cliff dwellings near by and become a child of nature again.

To reach this interesting region people from the north and west should leave the Denver and Rio Grande Railroad at Thompsons and take the stage to Moab, a ride of 35 miles. From Moab one must travel by private conveyance to Monticello, 60 miles farther. At Monticello saddle horses and pack animals can be secured for the trip of 50 miles over Elk Ridge to the bridges. Parties coming from the east or south should leave the railroad at Mancos, Colorado, taking



THE AUGUSTA BRIDGE: HEIGHT, 222 FEET; SPAN, 261 FEET

Photo and copyright by S. M. Young

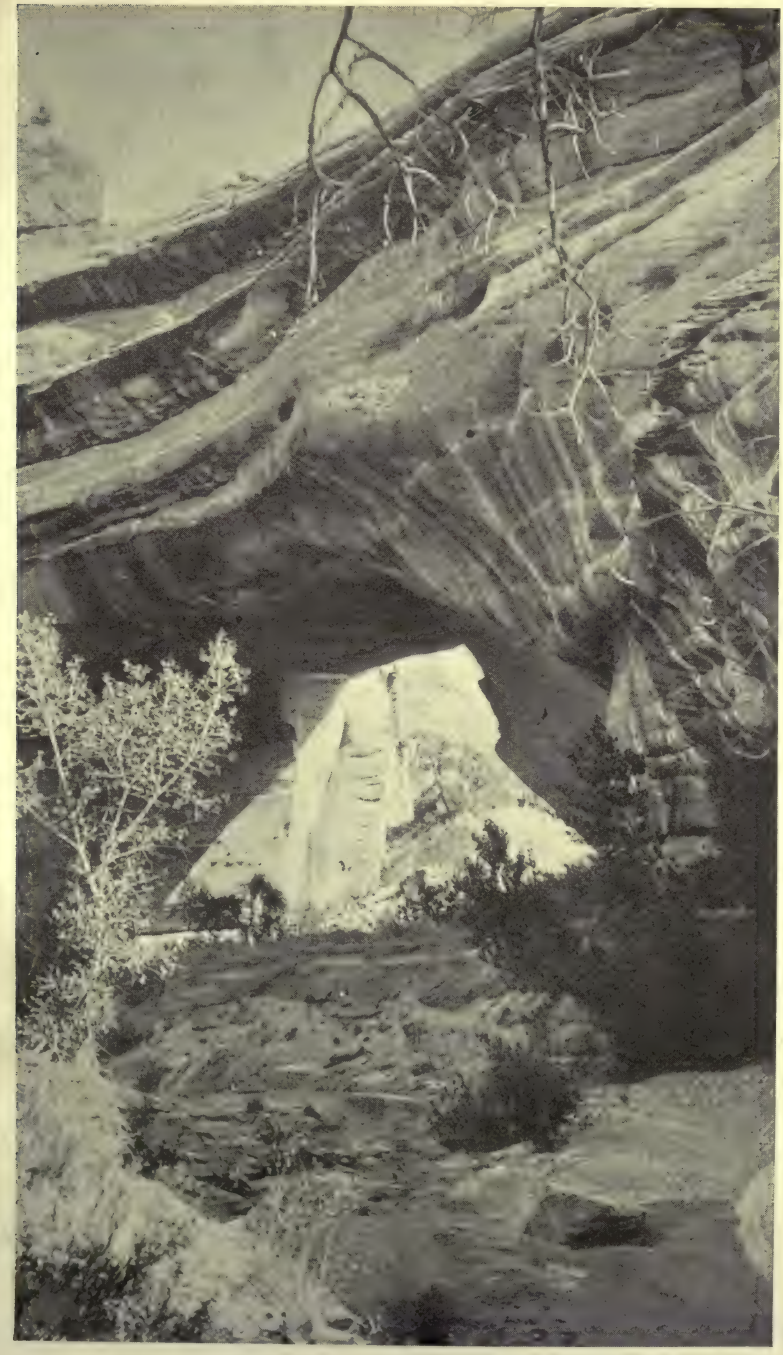


Photo and copyright by S. M. Young

THE CAROLYN BRIDGE: HEIGHT, 205 FEET; SPAN, 186 FEET

Photo and copyright by S. M. Young

THE GREATEST NATURAL STONE ARCH KNOWN—THE NONNEZOSHI ARCH: HEIGHT, 308 FEET; SPAN, 275 FEET

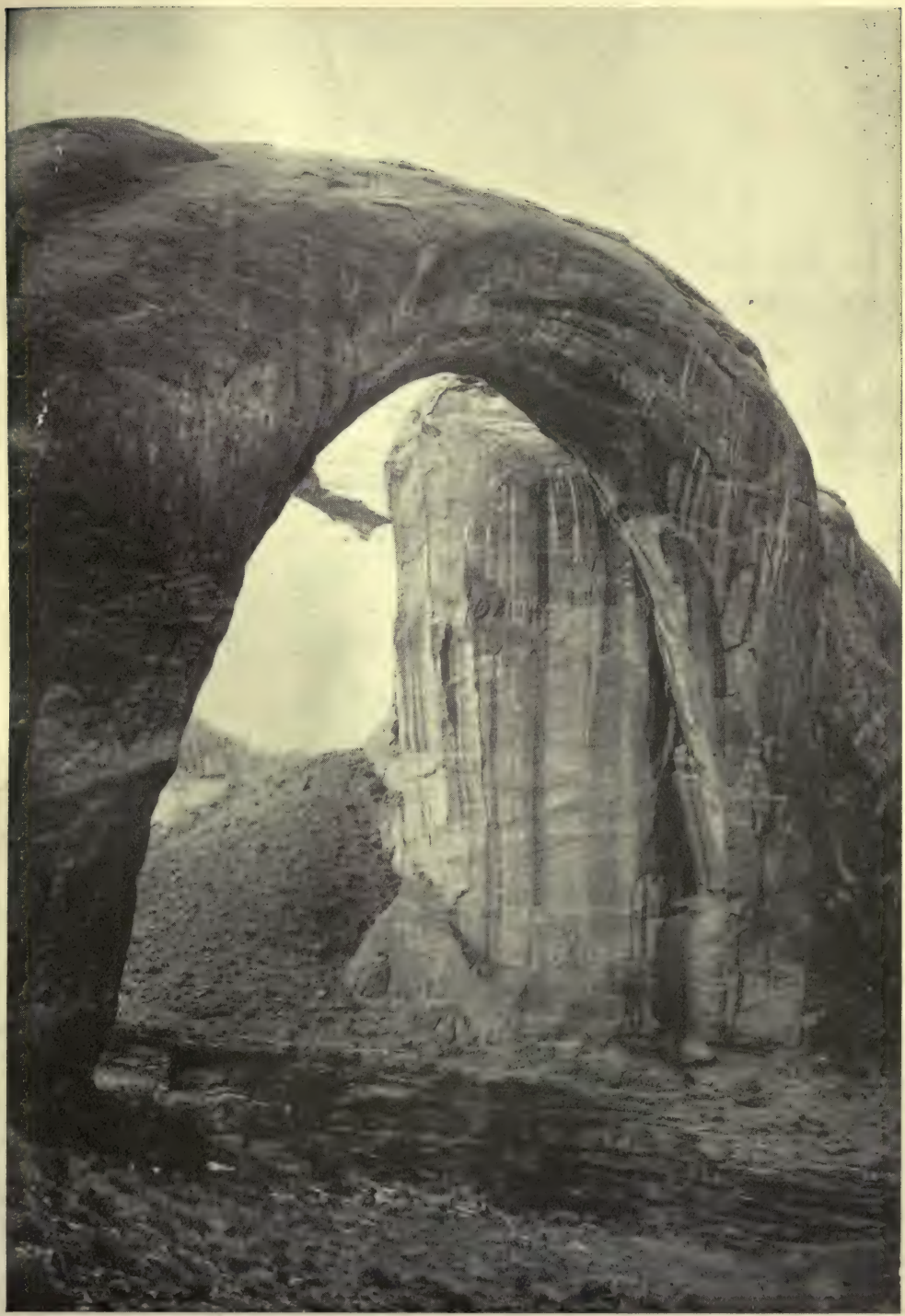


Photo and copyright by S. M. Young

ANOTHER VIEW OF THE NONNEZOSHI ARCH

Photo and copyright by S. M. Young

THE PRITCHETT VALLEY BRIDGE NEAR MOAB: HEIGHT, 49 FEET; SPAN, 122 FEET

the stage to Bluff, a distance of 75 miles. From Bluff one must travel with saddle and pack animals 55 miles northwest to the bridges. Both these routes seem long, hard trips by stage and on horseback, but if one enjoys outdoor life every hour of the trip will be a delight and the atmosphere will prove a veritable "fountain of youth."

THE LARGEST NATURAL BRIDGE KNOWN

By going down the San Juan River from Bluff 25 miles to the new oil town of Goodridge and crossing the river over the new steel bridge now nearly completed, and then taking a southwesterly course of about 50 miles across the country, one may visit the recently discovered natural bridge known to the Indians as Nonnezoshi (the stone arch).

This is the largest natural arch yet found and measures 308 feet in height and 275 feet between the abutments. It extends from a bench on one side across into a cliff on the other and hence spans the canyon in which it is found. This canyon, called by the Indians Nonnezoshi-boko, extends from the slopes of Navajo Mountain northwest and joins the Colorado River a few miles below the mouth of the San Juan. It is a deep, irregular gorge, in places so narrow that one has to walk in the stream in order to make his way along its course. The arch is situated about 6 miles above the mouth of the gorge in an exceedingly picturesque and beautiful part of the canyon.

This region formerly belonged to the Navajo reservation, then was segregated and held open to entry for a time, and now is included in that part of Utah recently set aside as a reservation for the Pahutes. It is seamed by deep gorges extending north and northwest toward the San Juan and the Colorado and broken by high cliffs and stretches of smooth, steep sandstone, so that it is almost impenetrable.

Few even of the Indians are well acquainted with this region. It is celebrated as the place where Hoskinimi, one of the most revered leaders among the Navajo, successfully evaded Kit Carson, in 1866, when the latter taught the Navajo such a terrible lesson; but not even Hoskinimi seems to have penetrated as far as the Nonnezoshi. The members of the Utah Archeological Expedition and of surveying party of the U. S. General Land Office, who visited the bridge together August 14, 1909, are evidently the first white men to have seen this greatest of nature's stone bridges.

As shown by the accompanying illustrations, this remarkable freak in the earth's crust is hardly a bridge in the true sense of the term, but is more properly an enormous flying buttress that has been chiseled out by the ages and left as a specimen of the handiwork of the Master Builder. The surface formation of this section is the same thick bed of red and yellow sandstone found in the region of White Canyon, and Nonnezoshi has been cut out of the cliff in the same manner that the White Canyon bridges were formed. It is a graceful arch, looked at from any position, and is only about 20 feet thick in the narrowest part.

This slender arm of the cliff stretches out across the canyon like a rainbow. In its shadow on the bench at one side are the remains of what was probably an ancient fire shrine. One can easily imagine a group of cliff-dwellers gathered around the sacred fire with offerings to the Sun Father and the Earth Mother. The Pahutes look upon it with awe, and Mr C. A. Colville, who took a party there in November, tells us that their Pahute guide, Whitehorsebiga, would not pass beneath the arch because he had forgotten the prayer that must be said before doing so.

On the slopes of Navajo Mountain you pass two smaller arches that would each be an attraction by itself were they not overshadowed by the grander Nonnezoshi.

In Pritchett Valley, 12 miles by trail southeast of Moab, in Grand County, is a stone arch that plainly has been formed in a different manner from those above described. All about this valley the

THE EDWIN NATURAL BRIDGE: SAN JUAN COUNTY, UTAH Photo and copyright by Chas. Goodman

Span of arch, 194 feet; height of arch, 98 feet; thickness of arch at keystone point, 10 feet; total height, 108 feet; width of roadway on top, 32 feet (see page 158)

thick red and yellow stratum lies on the surface and stands out in weather-worn domes and spires that remind one of an ancient Moslem city.

In numerous places over these bare cliffs large cisterns have formed, into which rush the waters from the surrounding rocks every time a storm sweeps over this region. It happened that in one place where a cave was worn out of the side of the cliff one of these cisterns formed back of it in the cliff above. Gradually the cistern kept growing larger and deeper and the cave kept extending its area backward inch by inch until the bottom of the cistern broke through into the back of the cave near its floor. The rushing of wind and water with every storm has kept enlarging the opening until the arch of the cavern has become a graceful bridge having a height of 49 feet and a span of 122 feet. There are two other similar structures near this where the cisterns broke through at the back of the caves near the top so that you have the arch in front and an immense skylight at the back. The architect has not yet finished the contract. Here natural bridges can be seen in process of construction.

In Dark Canyon, below the western slope of Elk Ridge, is another arch that has been shaped from the cliff under conditions similar to those that produced the natural bridges in Pritchett Valley. Its span of more than 100 feet forms a regular curve on the side of a slope heavily wooded with pinion and cedar.

The above are the most striking examples of the great natural arches of southern Utah. They should be classed among the world's wonders.

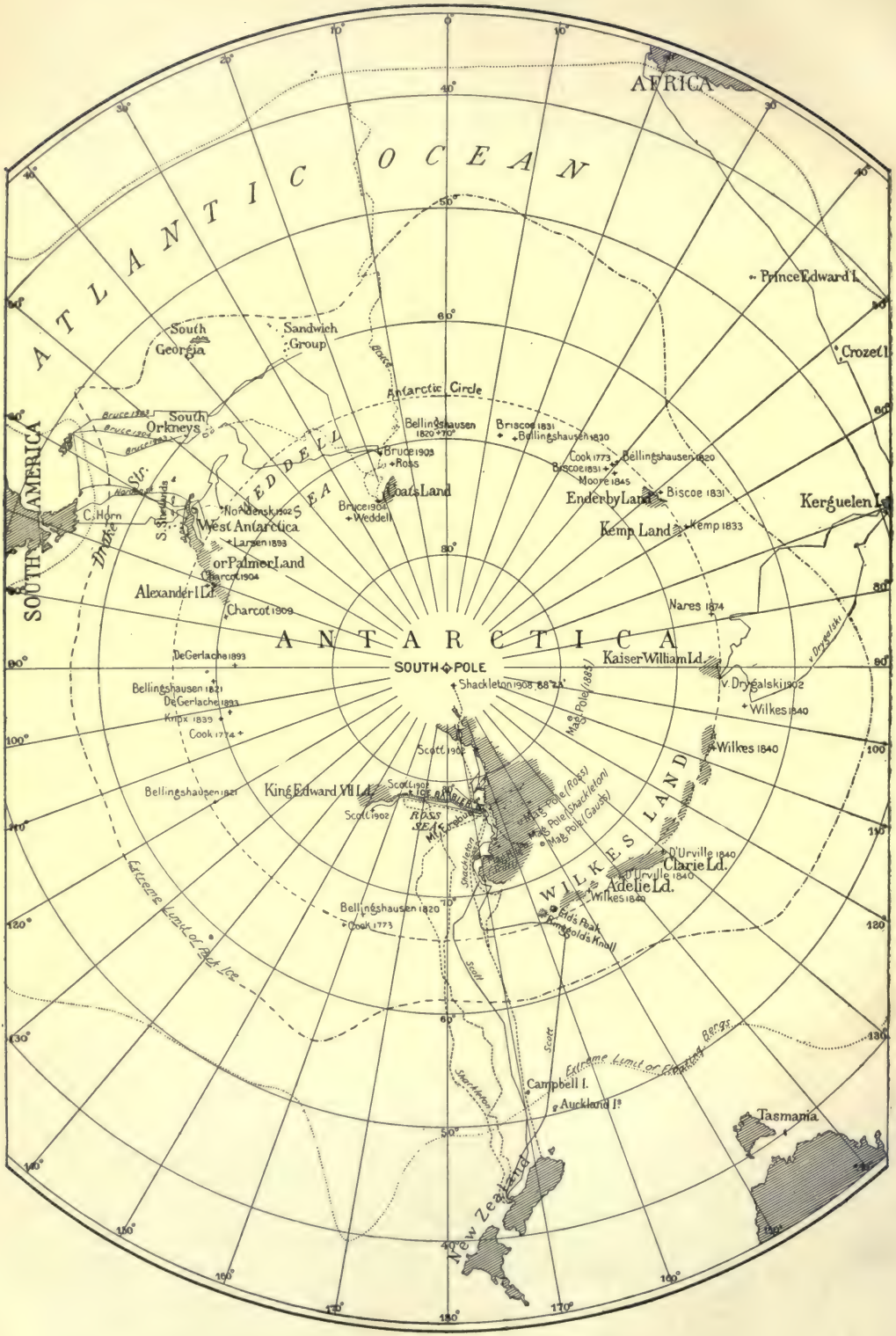
THE SOUTH POLAR EXPEDITION

To the Members of the National Geographic Society:

ON February 1 Commander Robert E. Peary made a proposition to the Board of Managers of the National Geographic Society that the Society and the Peary Arctic Club should together send out an expedition to the South Polar regions to explore the coast of Weddell Sea and, if possible, reach the South Pole via this route. The proposed expedition would leave the United States in August of this year and cross the Antarctic circle about January 1, 1911. Commander Peary offered on behalf of the Peary Arctic Club to place the steamship *Roosevelt,* which it will be remembered was built by the Club specially for polar work, at the disposal of the expedition, provided the Society would assume the initial expense of $50,000. He also proposed that expenses above $50,000 be divided equally between the Peary Arctic Club and the National Geographic Society. He estimates the total expense of fitting out and maintaining an expedition in the South Polar regions for one year at between $75,000 and $100,000.

Commander Peary stated, moreover, that the *Roosevelt* was in very good condition; that she could not be duplicated at present for considerably over $100,000, and that all the equipment of his recent polar expedition, including sledges, fur clothing, and camp equipment, would be placed at the disposal of the party, and that if funds could be found for the expedition Captain Bartlett and the major portion of the members and crew of his last expedition, who were of such invaluable assistance to him in his conquest of the pole, would be glad to take part in the work. He himself was ready to devote his time and energy to planning and equipping the expedition, but could not take command of the party. Captain Bartlett will command the expedition.

Your Board of Managers agreed with Commander Peary that the present is a most opportune time for an American expedition to the Antarctic. A British expedition under Captain Scott will leave England about August, 1910, and spend the year of 1911 in Victoria Land and will attempt to reach the South Pole



SKETCH MAP OF THE SOUTH POLAR REGIONS

from that quarter. Simultaneous observations taken by an American party exactly opposite the English base would be of great benefit to science.

Your Board of Managers referred the matter for consideration to the Finance and Research Committees of the Society. On February 8 favorable reports from these two committees were received by the Society. The following resolution was thereupon unanimously adopted by the Board:

"*Resolved:* The National Geographic Society believes that it is of great importance to science that tidal, magnetic, and meteorological observations shall be obtained at or in the vicinity of Coats Land during the same period that the British expedition under Captain Robert F. Scott, R. N., is making similar observations on the other side of the Antarctic area, 1,800 miles distant, and at the same time that this recently discovered land shall be explored.

"The Society is ready to accept Commander Peary's proposition that it shall undertake jointly with the Peary Arctic Club an expedition to the Antarctic regions, provided that the Board of Managers, after consultation with the members of the Society, finds that the project will receive sufficient financial assistance to warrant the undertaking."

The Board of Managers heartily endorse Commander Peary's project, and, if the resources of the Society were larger, would make an appropriation for the work. All our funds, however, are required at home.

The membership and popularity of the National Geographic Society have been increasing so rapidly that the Association requires additional space for its working force. During the past year the Society has expended about $40,000 in purchasing a frontage of 85 feet on Sixteenth street, with a depth of 90 feet, adjoining its present home. Your Board of Managers propose on this site to erect an additional building which will afford room for the clerical force of the Society and for the future growth of its business. This expenditure will require all of the available funds of the Society.

We realize, however, the unusual opportunity afforded the National Geographic Society by Commander Robert E. Peary for the increase of geographic knowledge of the South Polar regions. We believe not only that the members of the Society should be given an opportunity, but that they should be urged to assist the project.

An American expedition could be equipped at the present time with great economy of money, could benefit by Commander Peary's unequaled experience of polar conditions, and could use the officers and crew picked and trained by him during many years of campaigns on the ice.

As Peary says, "At some sacrifice and cost of time and money on my part, and large cost of money on the part of my friends, a certain capital of experience and equipment has been assembled which has no duplicate, and I feel that it is perhaps a duty not to let that capital be thrown away when a little further expenditure of time and effort will enable it to bring in still greater returns."

As evidence of his desire to see an American expedition despatched in search of the South Pole, Commander Peary has deposited $10,000 in a New York bank as his subscription to such an expedition. This sum had been presented him by Governor Hughes on behalf of the American people February 8 at a large meeting in the Metropolitan Opera House.

No region in the world presents such problems for exploration and the advancement of science as are to be found around the South Pole. Here is a continent greater than the United States and Alaska combined, much larger than Europe, which has been penetrated in only one direction, namely, by Scott and Shackleton from Victoria Land. Even its coast lines are little known. It is believed that the greater part of this continent ranges in altitude from 8,000 to 14,000 feet above the sea, making it probably the largest continental mass above sea-level in the world.

Planted on the fringe of this vast continent of snow and ice are lofty volcanoes like Terror and Erebus, which are belching continually smoke and fire. Here lives the most remarkable bird known to science, the penguin, which lays its egg on a cake of ice in the blackness of a polar night, when the temperature is not less than 30° below zero, and then holds the egg and chick on its feet until the young bird can take care of itself.

A glance at the map shows the dense pack ice which surrounds the Antarctic area and makes the approach to land so difficult from all directions. But the great engines and heavy frame of the *Roosevelt*, which is more powerful than any vessel hitherto employed in South Polar work, should enable her to pound a path where previous ships have been helpless, and thus to carry the American party to an advantageous base. Exactly where this base shall be cannot be determined until the party get in the ice and find where they can go, but Commander Peary proposes that the American expedition should make its headquarters somewhere on the coast of Weddell Sea, probably in the vicinity of Coats Land, which was discovered by Captain Bruce, of the Scottish expedition, in 1904. It is hoped that a base can be found here less than 900 miles from the pole. The primary object of the expedition would be to plant the Stars and Stripes at the South Pole, but for those who seek a different motive, it should be explained that every mile made from Coats Land to the pole would be over unpenetrated and unknown regions.

This section is probably the least known in the Antarctic area. Bruce succeeded in getting within a few miles of the coast, but he did not land. Ahead of him were ice-clad slopes which he believes ascend to a plateau which may be an extension of Victoria Land. All explorations in this region would be absolutely new discoveries and would benefit geology, zoology, and all kindred sciences.

If the plan of exploration outlined above is put into successful execution we hope it will arouse such interest that our government or an association of scientific organizations, or both in combination, will later undertake the exploration and scientific investigation of the entire circuit of the unknown Antarctic regions, including the exploration of Wilkes Land and the verification of discoveries made 70 years ago.

Campaigning against the pole in some respects is easier in the South than in the North. The weather is much harsher and more boisterous in the South, but the working season is longer. The North Pole is surrounded by an ice-covered ocean, which must be crossed in spring, before the ice breaks apart under the summer sun. The South Pole, on the other hand, is situated on a great ice plateau, which may be traversed during almost the entire period of daylight. Thus, while Peary was compelled to complete his dash from the most northern land to the pole and back in a period of less than 60 days, the South Polar explorer has more than 120 days at his disposal, and even this period can be extended by utilizing Peary's methods and equipment.

WILKES' AND D'URVILLE'S DISCOVERIES IN WILKES LAND

By Rear Admiral John E. Pillsbury, U. S. Navy

In January, 1840, two national expeditions were in the Antarctic, one the United States Exploring Expedition, consisting of four ships, the *Vincennes, Peacock, Porpoise,* and *Flying Fish,* under the command of Lieut. Charles Wilkes, U. S. Navy, and the other a French expedition, consisting of *L'Astrolabe* and *La Zélée,* under command of Capitaine de Vaisseau M. J. Dumont d'Urville.

It has generally been accepted by foreign authorities that d'Urville sighted the land of the Antarctic Continent, which he named Adélie Land, on the same day (January 19) that Wilkes discovered land 400 miles to the eastward, which he named Cape Hudson, and also that d'Urville's Cote Clarie, in longitude 131° east, was sighted by him the day before it was seen by Lieutenant Ringgold, on board U. S. S. *Porpoise.*

Investigation shows that both of these assumptions are in error, and in fact d'Urville first sighted Adélie Land the day after Wilkes sighted Cape Hudson, and he sighted Cote Clarie the same day that it was sighted by Ringgold, but at a later hour. The story of the investigation which led to these conclusions will be given in the order in which it was made.

In d'Urville's narrative it is stated under date of *January 29* that at 4 p. m. he sighted one of the ships of the American expedition (the *Porpoise*) and he "hoped that she intended to speak us." Through a misunderstanding of the maneuvering of the French flag-ship, Ringgold thought d'Urville wished to avoid a meeting, and, although but "a cable's length distant" from the ship, he put his helm up and stood off to the southward.

Ringgold states that at 4 p. m. *January 30* he sighted two ships which afterwards proved to be the French vessels. He approached them "within musket shot," when to his surprise he saw them making sail, whereupon he hauled down his colors and stood off before the wind.

The discrepancy in dates was not noticed in reading the narratives, but, wishing to see just where the meeting of the ships took place, their tracks were plotted on the same chart, when it appeared that the noon positions (d'Urville's January 29 and Ringgold's January 30) were near each other, and that the tracks crossed in the afternoon.

The discrepancy in dates seems to be remarkable, since both expeditions had crossed the 180th meridian from east to west some months before and had sailed for the Antarctic — one from Hobart Town, Tasmania, and the other from Sydney, Australia, where the dates must have been identical.

We find in Wilkes' narrative, volume 2, page 159, this statement: "On crossing the meridian 180° we dropped the 14th of November, in order to make our time correspond to that of the Eastern Hemisphere, to which our operations were for some months to be confined."

That d'Urville made no change of date in crossing the 180th meridian, but maintained the same chronology, appears from d'Urville's narrative, "Routes des Corvettes," volume I, page 134, where, under date of October 13, 1838, the longitude is given as 179° 31′ west, and on page 136, under date of October 14, 1838, it is given as 178° 53′ east. He therefore made no change of date in crossing the 180th meridian, as otherwise the second date would have been October 15 instead of October 14.

Further investigation of d'Urville's daily positions shows that every day is accounted for until June 22, 1840, which appears in volume 1, page 340. On page

342 appears the date of June 24, with an asterisk, and at the bottom of the page is this note:

"Nous reprenons la date d'Europe,"

so that the date he dropped was June 23, 1840, five months after the visit to the Antarctic and more than twenty months since he crossed the 180th meridian.

This means that in d'Urville's narrative of his discoveries and on the chart of his Antarctic voyage every noon position must have its date advanced one day in any comparison to be made with the noon positions and the discoveries of Wilkes' ships.

Wilkes believed that he sighted the Antarctic Continent on January 16, 1840, at about 158° east longitude. On January 19, however, he states that "land was now certainly visible from the *Vincennes,* both to the south-southeast and southwest, in the former direction most distinctly. Both appeared high," etc.

D'Urville says, in volume 8 of his narrative, under date of January 19 (which should be January 20, to correspond with Wilkes' time), "At 9 a. m. we saw in the E. S. E. a great black cloud, which seemed stationary and had the appearance of a raised island." "Toward 3 p. m., M. Gervaize, who was officer of the watch, thought he saw once more an indication of land in the east." "At 10:50 p. m. this luminary (the sun) disappeared and showed up the raised contour of the land in all its sharpness." This land on January 21 (true date, 22) he named Adélie Land.

Returning now to the meeting of the *Porpoise* and the French vessels. On the day following the meeting d'Urville reports: "At 6 o'clock the man on lookout had sighted the ice pack to the south and I brought the ship to the wind in order to go nearer to explore it. At 10 o'clock we were not more than three or four miles distant. It appeared prodigious. We saw a cliff with a uniform height of 100 to 150 feet, forming a long line westward," etc.

It will be noticed that at 6 o'clock the *ice pack* and not the *barrier* was sighted.

Wilkes' narrative of the movements of the *Porpoise* for this day states: "The beginning of the 31st the gale continued; at 7 a. m., moderating, they again made sail to the westward; in half an hour discovered a high barrier of ice to the northward, with ice islands to the southward; at 10 a. m. they found themselves in a great inlet formed of vast fields of ice which they had entered twelve hours previously; the only opening appearing to the eastward, they were compelled to retrace their steps, which was effected by 8 p. m." "They now found themselves out of this dangerous position, and, passing the point, kept away to the westward."

"February 1.—The immense perpendicular barrier encountered yesterday was now in sight trending as far as the eye could reach to the westward," etc.

The *Porpoise*, therefore, at 7:30 a. m., January 31, was in the entrance of the great inlet on the southeast side of d'Urville's "Cote Clarie," and had sighted the high barrier of ice, the northern side of which d'Urville reached about 10 o'clock the same forenoon.

It is established from this investigation that, even if Wilkes' sighting the Antarctic Continent on January 16 is not admitted, it is certain that he did sight Cape Hudson a day before d'Urville sighted Adélie Land, and that Cote Clarie was sighted by the *Porpoise* on the same day that it was seen by d'Urville, but at an earlier hour.

Wilkes cruised along the coast of this continent for more than 1,600 miles from his first landfall. Future exploration may, and, indeed, probably will, find that much of the land discovered by him was placed too near the barrier, or, in other words, too far north, for it is well known that distance estimated by the eye is liable to great error, and particularly is this the case in the polar regions.

Whether this proves to be so or not, this investigation establishes Wilkes' priority over d'Urville. The English sealer Balleny, in 1839, got a glimpse of land in about 121° east, but all he says regarding it is, "Saw land to the south-

ward." Neither d'Urville nor Balleny had any notion nor made any suggestion that they were on the edge of a continent. Wilkes, on the contrary, not only sighted at frequent intervals some 1,600 miles of this coast, but he recognized that it must be part of a continent. The name he gave to this land, the Antarctic Continent, must belong to the entire continent the existence of which he revealed. Some geographers have recognized that part of Antarctica he discovered needed a special name and therefore gave it the name of Wilkes Land. When it is remembered that Wilkes changed the conception that the Antarctic was an ocean by demonstrating that it was a continent, the least that his discoveries demand is that the name of Wilkes Land be retained on all of Antarctica lying between the longitudes of 95° and 158° east.

THE GREAT ICE BARRIER

By Henry Gannett

IN his notable expedition of 1840 to the Antarctic, James Ross discovered a great ice cliff rising from the sea to an average height of nearly 200 feet and stretching from King Edward VII Land to South Victoria Land, a distance of about 400 nautical miles. Of its origin nothing was known, and, although later expeditions also visited it, they added little to our knowledge. It was not until Scott, in 1902, and Shackleton, in 1907, made their remarkable sledge journeys in the interior of Antarctica that the nature of the Great Ice Barrier became known.

The barrier is simply the southern limit of a great sheet of ice extending southward up a great bay which penetrates the land at least 300 miles and possibly double that distance. Indeed, it is possible that it may extend entirely across, joining with Weddell Sea on the opposite side and dividing Antarctica into two continents. From the barrier southward this bay, with a known area of at least 100,000 square miles, is entirely occupied by this ice sheet. It is bordered on the west by high mountains from which stretches westward a still higher plateau, which reaches an altitude of over 11,000 feet at Shackleton's farthest southern point. The land on the east side of the bay is unknown, except at the point of King Edward VII Land, where the barrier joins it, but it also is probably mountainous.

From the high land on the west side numerous glaciers descend to this field of ice. Notable among them is that by which Shackleton ascended to the summit of the plateau in his wonderful sledge journey toward the South Pole, a glacier 100 miles long and 50 miles wide, with a descent of 8,000 feet. From the east side of the bay, and especially from its south end, probably other great glaciers contribute to the great ice field.

The name "Great Ice Barrier," originally applied only to the ice cliff forming its northern limit, has been extended and applied to the ice field itself, and even to the bay which it covers. It is unnecessary to say that these extensions in the application of the name are inappropriate, and it is to be hoped that suitable names will be selected for these features. I would suggest for the ice field the name of Shackleton glacier, since Shackleton has made the most extensive explorations of it and its surroundings; moreover, I hope to show that it is in truth a glacier, although both Scott and Shackleton refuse to accept that explanation of the phenomenon. It is their belief that it has been formed from snow falling upon its surface much as the sea-ice of the Arctic is formed. But sea-ice nowhere accumulates to any such thickness as this or presents an ice wall at its borders.

On the other hand, every glacier that reaches the sea presents just such an ice wall. There are scores of such glaciers on the Alaskan coast, and probably hundreds on Greenland, Grant Land, and Spitzbergen, whose fronts extend out into the sea, even into water so deep that they must be afloat, as is much of the barrier.

The snow which falls upon the surface of this ice field could not possibly supply the waste from the barrier, and another source of supply must be found. This supply is in the numerous and large stream glaciers which bring down the ice from the highlands on the east, west, and south of the bay. The area thus drained must be enormous—amply sufficient to maintain the supply.

The fact that this great ice field is moving northward at the rate of about one-third of a mile a year, as ascertained by Shackleton, would seem in itself as a conclusive demonstration that it is a glacier. Sea-ice, unless driven by wind or currents, is quiescent, while the glacier always moves toward lower levels.

Thus Shackleton glacier is a great mother glacier, into which drains the snow and ice from enormous areas of highland. This glacier collects the ice and transports it northward to the Great Ice Barrier, where it is dropped as bergs into Ross Sea.

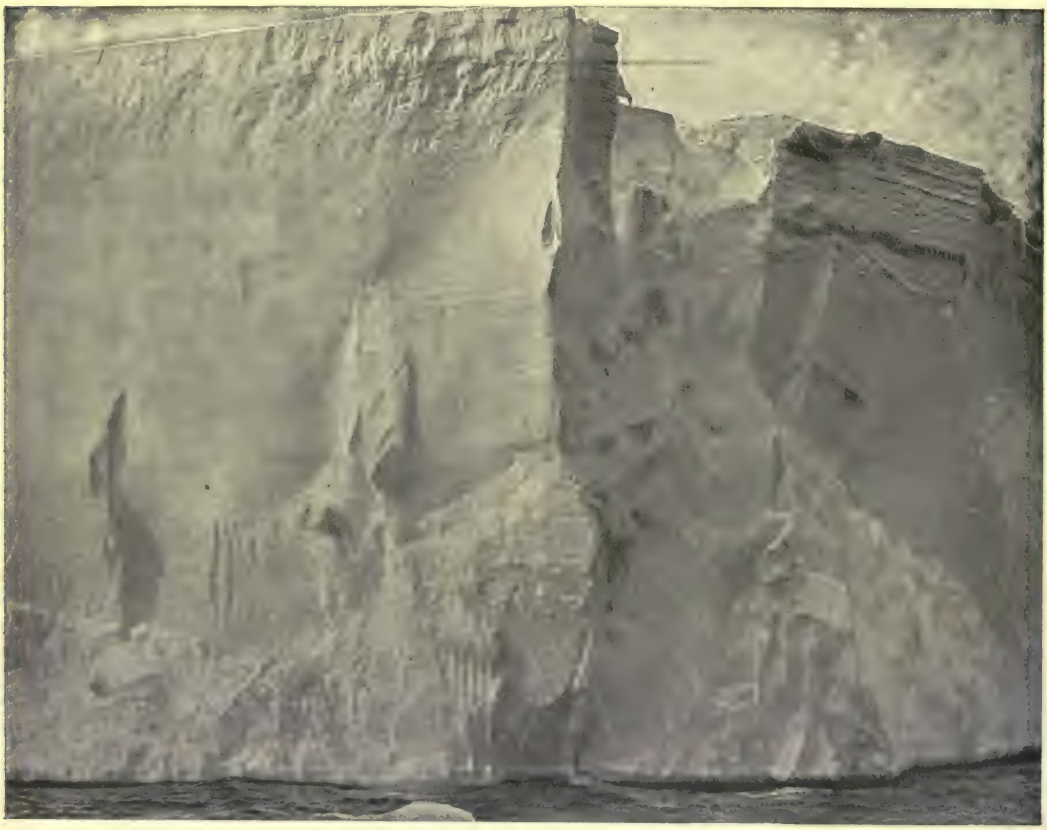


Photo from Capt. Robert F. Scott, R. N.

FRONT OF THE GREAT ICE BARRIER

THE BARRAGE OF THE NILE

By Day Allen Willey

THE most historic and one of the greatest inland navigation waterways is the Nile, the river and its tributaries affording over 4,000 miles suitable for the passage of steamers and other craft between North and East Africa and Cairo.

The head of the navigable waterways may be said to be the town of Gondokoro, on the White Nile, about 1,000 miles above the city of Khartum. Gondokoro is the terminus of several caravan routes extending into the Congo, as well as Uganda and Unyoro. Small steamers ply upon the water-courses between Khartum and Gondokoro, connecting at the former city with steamers for Cairo. In recent years tourists have extended their trips from the Lower Nile as far as Gondokoro, but the rivers are utilized principally for the transportation of products from the territory beyond Gondokoro and to Khartum.

There is one very serious obstacle on the section of the Nile between Khartum and Gondokoro which has at times obstructed the channel so that continuous navigation has been delayed months at a time. This is the vegetation growth known as sudd, which is a translation from the Arabic term El Sett.

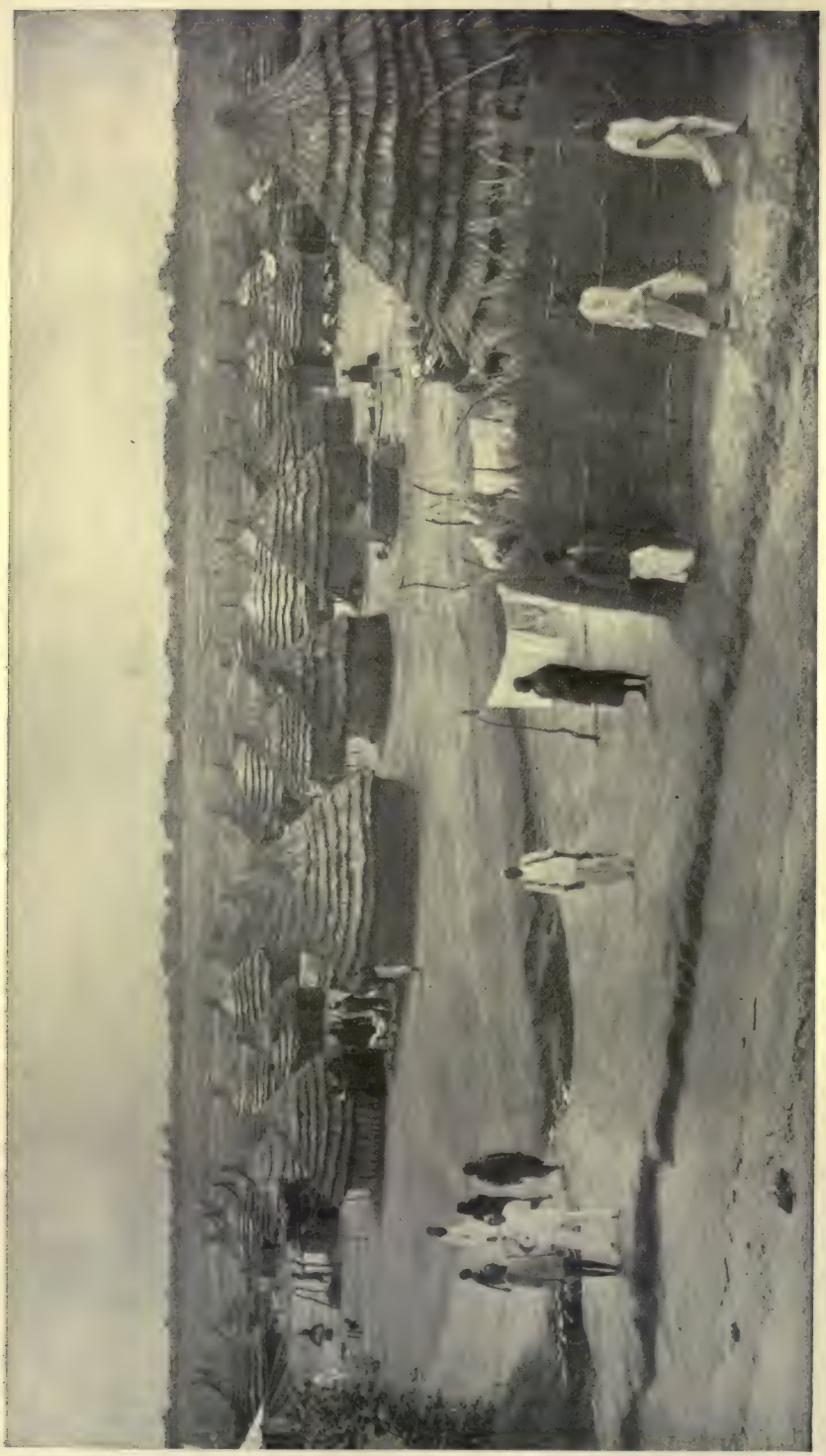
On one occasion the channel was blocked by a bar of sudd which actually measured 25 miles along the channel, while within a distance of 150 miles were three more growths aggregating no less than 60 miles. A fleet of vessels especially equipped and a large force of men were working continually for nearly six months before an opening large enough for the smallest river steamer could be made through the mass.

In studying the growth the investigators have found that it is more rapid under certain conditions. For example, it spreads very rapidly after an unusually extensive flood in the upper rivers, which carry down such an amount of sediment and vegetation, while when the rainy season is short the growth is checked considerably, and the current in the upper rivers is usually strong enough to carry out the young vegetation before it becomes dense enough to be able to resist the action of the water.

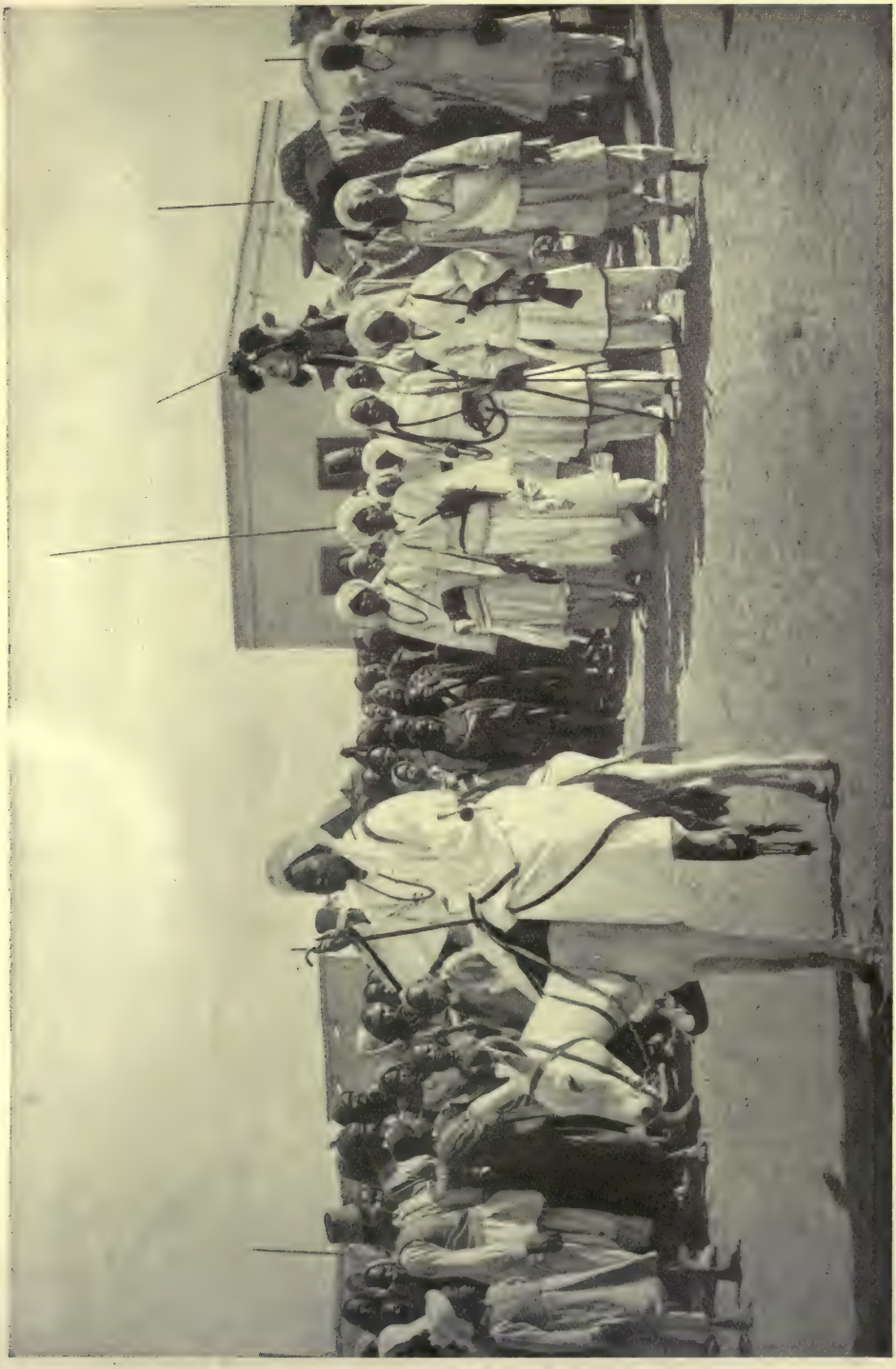
Since the obstruction of the Nile has such a serious effect in interrupting the transportation between upper and lower Egypt and in cutting off what is really a route between Cairo and Mombasa, the Egyptian government has built a fleet of steamers and barges especially constructed for removing the sudd and retains a large force of men in removing and destroying the vegetation. These vessels are stationed at different points on the Upper Nile, so that they may reach an obstruction without delay.

In clearing the river channel of sudd the engineers have devised several schemes. The top growth frequently becomes so dry that they can burn it over like so much grass. This removes much of the weight of the plants, but they are so matted together that saws are actually used to separate the growth, as it cannot be removed in any other way. The vessels employed for sudd clearing, while light-draft boats, are strongly built and have blunt bows, so that they can be forced against the bank of vegetation. They are provided with steel cables or hawsers, saws, and axes, and carry crews of natives who are experts in working upon the sudd.

The way in which the channel is cleared is as follows: Often the water is so completely hidden that the first difficulty when you are encountered by a barrier of sudd is to discover where in this sudd the river bed runs. This is done by "sounding" through the sudd with long poles. The average depth of water in the sudd may be only a few feet, but when the actual river bed is reached this suddenly increases to a



VILLAGE SCENE ON THE NILE NEAR GONDOKORO



SCENE ON THE NILE ABOVE KHARTUM

A SUDD SWAMP ON THE EDGE OF THE NILE, SHOWING THE DENSITY OF THE VEGETATION: CUTTING OFF THE TOP TO DESTROY IT: THE RIVER IS FLOWING BENEATH

SUDD-CLEARING STEAMER TEARING OUT THE OBSTRUCTION WITH STEEL CABLES

HOW SUDD BLOCKS THE NILE CHANNEL: A VIEW OF A BAR OF IT ACROSS THE RIVER, WITH A STEAMER HELD UP

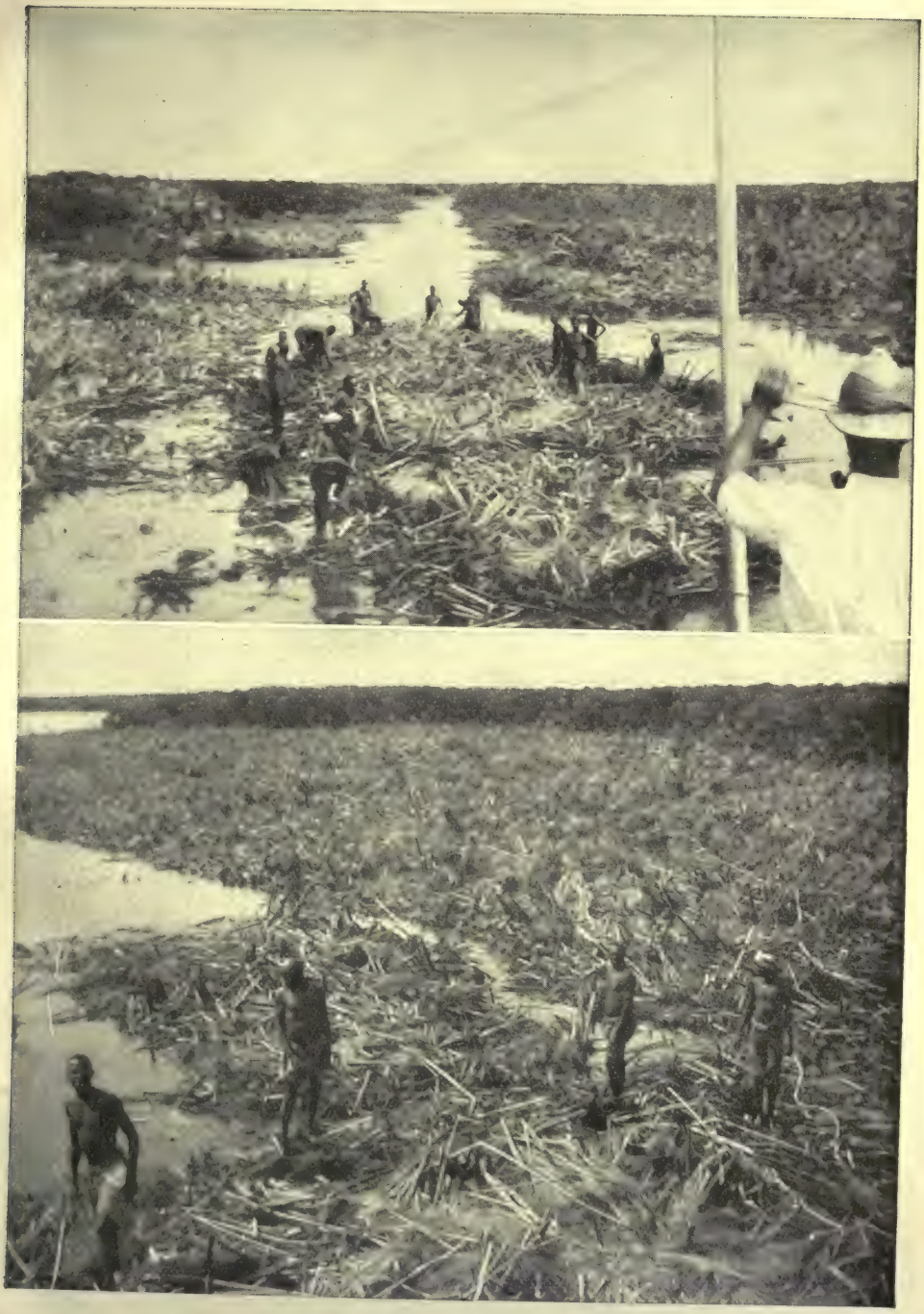
A SUDD ISLAND IN THE CHANNEL, SHOWING HOW IT SUSTAINS WEIGHT ON ACCOUNT OF ITS DENSITY

SUDD-CLEANING STEAMER RUN INTO A MASS OF IT TO TEAR OUT THE GROWTH: THE BOW OF THE BOAT CAN BE SEEN IN THE LEFT-HAND CORNER OF THE PICTURE

THE SUDD IS SO DENSE AT TIMES THAT IT IS NECESSARY TO CUT OFF THE TOP GROWTH OR BURN IT OFF BEFORE PULLING THE MASS APART

SUDD-CLEARING STEAMER TEARING OUT THE OBSTRUCTION WITH STEEL CABLES

THE TOP OF A SUDD GROWTH REMOVED AND READY TO BE PULLED TO PIECES TO CLEAR THE CHANNEL



TOWING OUT A MASS OF THE GROWTH FROM THE CHANNEL

A MARKET SCENE IN NORTH AFRICA

Photo from Bishop J. C. Hartzell

A GIRL OF NORTH AFRICA Photo from Bishop J. C. Hartzell

depth of 15 to 18 or 20 feet. Having found the real river bed, the first thing to do is to cut down or burn the top growth, consisting mostly of papyrus.

Having cleared the top of the sudd "block," the men are landed with large saws to cut along the true river bank, which may be either submerged with a few feet of water over it and papyrus and sudd on it, or solid ground with ant heaps, the solid ground never being of any great extent and always surrounded by swamp. Cross and parallel cuts with the saws are then made through the sudd, dividing it into blocks of a convenient size for the steamer to tear out, the size of these blocks, of course, depending on the consistency of the sudd and the power of the steamer.

Having cut the sudd into convenient blocks, the bow of the steamer is run into the block, a loop of steel hawser is placed around it, when the rods of the cable are passed over the bows of the steamer. Here it is taken by the men on board and placed in what is called the trench cut, and held down with their feet. The steamer then goes full speed astern, the men all standing on the hawser to keep it in position. In the case of tough sudd, as many as twenty trials may have to be made before the block of sudd eventually tears away.

When the block is torn out, the steamer goes slowly astern till the mass is pulled clear into the current, if there is one, when it is cast adrift to float downstream, where it is gradually disintegrated. If there is no current, it is towed to a piece of open water, where as a temporary measure it can be tied by ropes to the bank, leaving a wide enough channel for the steamer, and on the appearance of a current to be cut adrift to float downstream.

While the composition of the sudd is usually the water papyrus, it is mixed with what is called elephant grass—a kind of bamboo growing to a height of 20 feet or more. To these climbs a creeper of a kind of convolvulus. Another portion of the sudd consists of ambatch and a long sword grass that cuts like a knife.

Strange as it may seem, the sudd interferes but little with the flow of the river, and the Nile passes under it with little resistance. This is because the growth is principally near or on the surface. As the river is over a mile wide in some places and the deep channel may be only a hundred feet, it is often hard to tell where to find the channel to clear it, as all of the water may be hidden.

The density of the vegetation even in deep water is remarkable. Again referring to the photographs, these show how the men can walk over it without sinking into the mass, such is its tenacity and strength. Animals such as the rhinoceros have been seen crossing the Nile upon this great water carpet, which is woven as deftly and strongly as by the loom.

NATIONAL GEOGRAPHIC SOCIETY

LIEUT. SIR ERNEST H. SHACKLETON, who will spend April and May in the United States lecturing, will address the National Geographic Society March 26. President Taft will attend, and at the conclusion of the lecture, on behalf of the National Geographic Society, will present to Lieutenant Shackleton the Hubbard Gold Medal of the Society, which was awarded him some time since for his important explorations in the South Polar regions in 1908-1909.

March 4.—"A New Era for the South." Dr Charles W. Stiles. The speaker will describe the methods by which science and money hope to eradicate the hookworm, or "lazygerm."

March 11.—"The Waste of Human Life and Resources in the Mining Industry." Mr Joseph A. Holmes, of the U. S. Geological Survey. Dr Holmes will tell of the Government's efforts to stem the tide of fatalities, in which the United States leads the world at a ratio of three to one, and the Government's effort to devise ways of saving the great waste, not only of human life, but of our coal, gas, and other mineral resources. Illustrated.

March 18.—"The Panama Canal." Colonel George W. Goethals, Chief Engineer of the Panama Canal. Illustrated.

March 25.—"The Spirit of the West." Mr C. J. Blanchard, of the U. S. Reclamation Service. The wonderful agricultural development of the West since the work of irrigation was started by the Government and private enterprise. Illustrated and moving pictures.

March 26.—"Nearest the South Pole." Lieut. E. H Shackleton. Illustrated.

April 1.—"Patagonia to Paraguay—or the Story of Argentine." Mrs Harriet Chalmers Adams. Illustrated.

April 8.—"The Pearl Fisheries of Ceylon." Dr Hugh M. Smith, Deputy Commissioner, U. S. Bureau of Fisheries. Illustrated.

VOL. XXI, NO. 3 WASHINGTON MARCH, 1910

THE NATIONAL GEOGRAPHIC MAGAZINE

THE RACE FOR THE SOUTH POLE

INTEREST in the American expedition to the South Polar regions has been very much increased during the past month by the coming to the United States of Sir Ernest H. Shackleton. This distinguished explorer gave his first lecture in America in Washington, March 26, to 5,000 members and guests of the National Geographic Society. At the conclusion of the address the President of the United States, on behalf of the Society, presented him with the Hubbard Gold Medal of the National Geographic Society, recently awarded Sir Ernest for his important discoveries in the Antarctic regions and for gaining farthest south—88° 23′—January 9, 1909.

"No private citizen has ever received a more auspicious welcome to America. Statesmen, diplomats, scientists, artists, men of letters, and men of distinction in every walk of life united in a great chorus of greeting to one of the most distinguished Englishmen of the present day. The audience included the President of the United States, Commander Robert E. Peary, the Ambassador of Great Britain and the entire staff of the British Embassy, the ambassadors of France, Germany, Japan, and Mexico, the ministers of Costa Rica, Portugal, Norway, The Netherlands, Denmark, Switzerland, and Sweden, the Secretary of the Treasury, the Secretary of War, the Secretary of the Navy, the Secretary of Commerce and Labor, the Admiral of the Navy, and many Members of Congress. Shackleton bore the honors crowded upon him with the spirit which he has shown since he emerged from the Antarctic regions nearly a year ago—with modesty and simple grace."

The expedition which formed the subject of his address has been fully described in previous numbers of the NATIONAL GEOGRAPHIC MAGAZINE.* Sir Ernest will repeat his lecture in many parts of the United States during April, May, and June.

His narrative is one of the most inspiring stories of adventure and accomplishment ever told, the courage, wit, pluck, resourcefulness, and good comradeship of the leader and his men making a most thrilling tale. Particularly interesting are moving pictures of the strange penguin, a bird 4 feet in height and weighing 90 pounds, which cannot fly and waddles something like a seal.

Lieutenant Shackleton holds the record, not only for getting 400 miles nearer the South Pole than any of his predecessors, but also for the unparalleled importance of his contributions to scientific knowledge of conditions in the far south. The cost of his expedition was much greater than the funds he had personally raised, so that when he returned to England in 1909 he found himself $175,000 in debt. The British government knighted him for his achievements and made him a grant of $100,000. The balance he is now paying off by lectures and by his book, "The Heart of the Antarctic."

* NAT. GEOG. MAG., April and November, 1909.

PRESENTATION OF THE HUBBARD MEDAL BY PRESIDENT TAFT

Sir Ernest Shackleton: It is my pleasant duty to represent the National Geographic Society in presenting to you the evidence of its high appreciation of the marvelous work that you have done in the cause of science; and the endurance, courage, and intelligence shown in the pursuit of a definite object. I am sure that you will the more appreciate this medal, as it comes from the National Geographic Society, that has among its prominent members that distinguished American, Commander Robert E. Peary, who, while you were working at the South Pole, was himself surrounding the North Pole.

I do not know that nature had in mind the variety that was to be added to the lectures by the differences between her at the North Pole and at the South Pole, but certainly the different character of the surroundings of the North Pole and the South Pole make of entrancing interest the stories with respect to both.

You will permit me, therefore, to have the honor of handing you the medal of the Society, which gives its evidence of how highly they appreciate your services to science and to mankind.

RESPONSE BY SIR ERNEST SHACKLETON.

Mr. President: It is a very great honor for me to have this medal from the National Geographic Society, and especially as it is given to me by the hands of the distinguished President of the United States. It could not mean more for me than to have it given in this way in this great hall. But while I am standing I would like to say that Commander Peary will have as warm a welcome over in England as I have received from your great American society tonight. Commander Peary's work belongs not only to America, but to the world.

We are all pleased, and we wish, of course, a good measure of success to any forthcoming American expedition to the South Polar regions, because they have got a very hard job to tackle on the other side.

And, sir, I thank you. It is a very great honor to me. I thank you very much for having presented this medal.

THE RACE FOR THE SOUTH POLE

During the past month each member of the National Geographic Society has received an invitation to subscribe to the American expedition to the South Pole under the auspices of the Peary Arctic Club and the National Geographic Society. Such generous responses have been received from a large body of the members that it is believed the expedition will be able to leave in September.

Sufficient funds at this writing have, however, not been secured, and those members of the Society who are interested in the work and have not yet sent in their subscriptions are earnestly requested to do so immediately. The subscriptions range from $1.00 to $500. While large subscriptions are welcome, the Society hopes that all members will be sufficiently interested to subscribe from $1.00 to $5.00.

The reasons why an expedition should leave this year are as follows:

1. The expedition can be equipped at approximately one-half the cost necessary to equip an expedition any other year, owing to the fact that the *Roosevelt* and all the material used on Commander Peary's last expedition are immediately available.

2. Peary's four lieutenants—Captain Bartlett, George Borup, McMillan, and Doctor Goodsell—and practically the entire crew of the last expedition are eager to join the American South Polar Expedition, provided it can leave this year. The American party could thus take advantage of men whose experience in polar work is unequalled.

3. From a scientific point of view, tidal and magnetic observations obtained at the same time that the English expedition are making simultaneous records on the other side of the South Pole will be vastly more important than if taken during another year, when there is no other expedition in the south. Similarly the work of the British expedition will be benefited by the American.

4. As Sir Ernest Shackleton has said, every step taken by the American expedition from its proposed base on the shores of Weddell Sea will be an entirely new discovery. No region in the world offers such an opportunity for the acquiring of new knowledge.

ROMANTIC SPAIN*

By Charles Upson Clark, of Yale University

SPAIN is still almost a *terra incognita.* The stern and yet fascinating country whose sons once dominated Europe and brought their language and their civilization to the western world has not yet been spoiled by the tourist. Cut off from the rest of Europe by the Pyrenees and the sea—forming, in fact, a detached bit of Africa—Spain has gone on through the centuries preserving countless ancient traits which give her life and people a peculiar stamp.

Since Spanish railways and hotels make traveling almost as simple a matter as in Italy, and the people are fully as courteous and honorable as any other, the American need not hesitate to include Spain in his itinerary, and may look forward to a wonderfully interesting experience. He will not, however, get the full benefit of it unless he is at home in Spanish history and not wholly ignorant of the language.

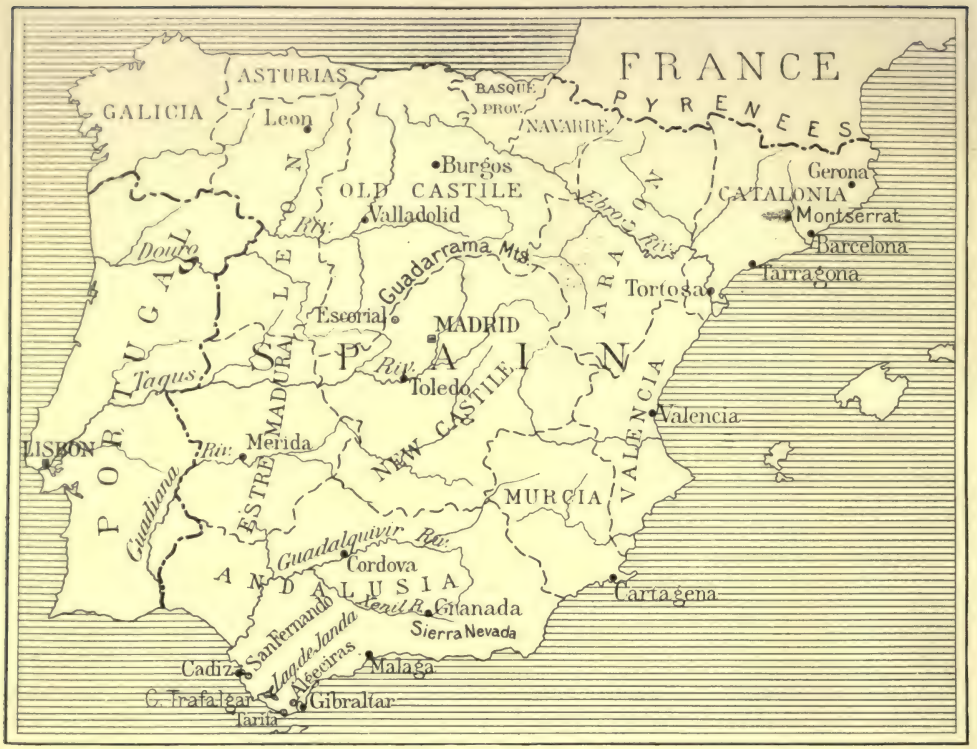
Nowhere else does the past, with its great warnings against pride, intolerance, and extravagance, so impress even the casual passer-by; and one is about as likely to find an English-speaking person in Spain as to find one who knows Spanish in New England.

Journeying into Spain from France, the traveler is promptly notified by a change of gauge at the frontier that even the railroads in Spain are different. Their gauge is over a foot wider than that of central Europe and of America; so passengers must change cars and freight be transshipped. This wide gauge is a great advantage, and American railroad men sigh for it. It enables more powerful locomotives and more capacious cars to be used, though the Spaniards have not yet risen to their opportunities. Their railway equipment is in general behind the times, although one or two through trains are equal to the best elsewhere, and I remember seeing a new Munich locomotive so powerful that it whisked twenty loaded passenger coaches up a grade with little effort.

By noticing the plaques on the engines, which tell when and where they were made, one can watch on Spanish railways the entire development of the locomotive. They come from everywhere, and seem never to be made into scrap. I have seen engines dating from the 50's still in use, and it was especially interesting to see machines which announce that they hail from Gravenhausen, Département du Bas-Rhin, thus proving that they date from before 1870, when Alsace became German territory.

European railroad practice is far behind ours in the use of air brakes on freight trains, and Spain is especially backward here, since few of her freight cars have even hand brakes. That leads to amusing methods of switching cars. When a brakeless car is started down its track the brakeman runs beside it and sets pebbles on the rail before it. These soon overcome its momentum. In the Madrid yards one sees a refinement of this system. At the end is a track running at right angles across the others; on this moves an electric engine, pushing a large platform on wheels, like one of our turn-tables. By means of a chain and capstan, the engine hauls the car to be switched upon this platform, and then pushes the load to the proper track. The car, when released, has considerable momentum; when the brakeman wants to stop it, he sets an ingenious iron shoe on the rail in front of the car. The car mounts the shoe, which is thereby knocked off the track; the brakeman

* The illustrations are from photographs by the author unless otherwise indicated.



SKETCH MAP OF SPAIN

picks it up, runs ahead and repeats the operation. Needless to say, the car soon stops.

The Spanish railways have the best mileage-book system in the world; the more mileage you buy, the lower is the rate per mile (or, rather, per kilometer) and the longer the validity. One book is good for a family or members of a firm. If one plans to travel several thousand miles, it is possible by the use of these books to ride first-class (that is, Pullman accommodations) for not much more than regular third-class rates.

But travelers who know a little Spanish and have learned by experience in other lands that the genuine people, whom one comes to know, travel third-class, go in with them, regardless of bare wooden seats and crowded quarters. One can be very comfortable with a rug or two; and, instead of sophisticated French-speaking travelers, one has as neighbor an intelligent Castilian farmer, who uses an American harvester and whose wife has an American sewing machine, and who laments Spanish illiteracy and official corruption as the chief cause of her troubles; or it may be a Barcelona commercial traveler, who lays Spain's ills—which all admit, saying, "Pobre España!" (poor Spain)—to her highly centralized administration, which taxes the whole country, and especially rich and populous Catalonia, for Madrid office-holders.

The ancient divisions of Spain, for centuries independent and often hostile countries, still hold somewhat aloof from each other. The Catalans even speak a different language, allied to Provençal, as different from Castilian as Dutch is from English. They are an enterprising

Photo and Copyright by Underwood & Underwood

THE GREAT BRIDGE WHICH SPANS THE GORGE OF THE GUADALEON AT RONDA, AND CONNECTS OLD AND NEW RONDA AT A HEIGHT OF 400 FEET

Photo and Copyright by Underwood & Underwood

FARM-HOUSE RESEMBLING SWISS CHALET, TYPICAL OF THIS SECTION OF COUNTRY: LAMONA, SPAIN: THE OXEN ARE YOKED BY THE HORNS

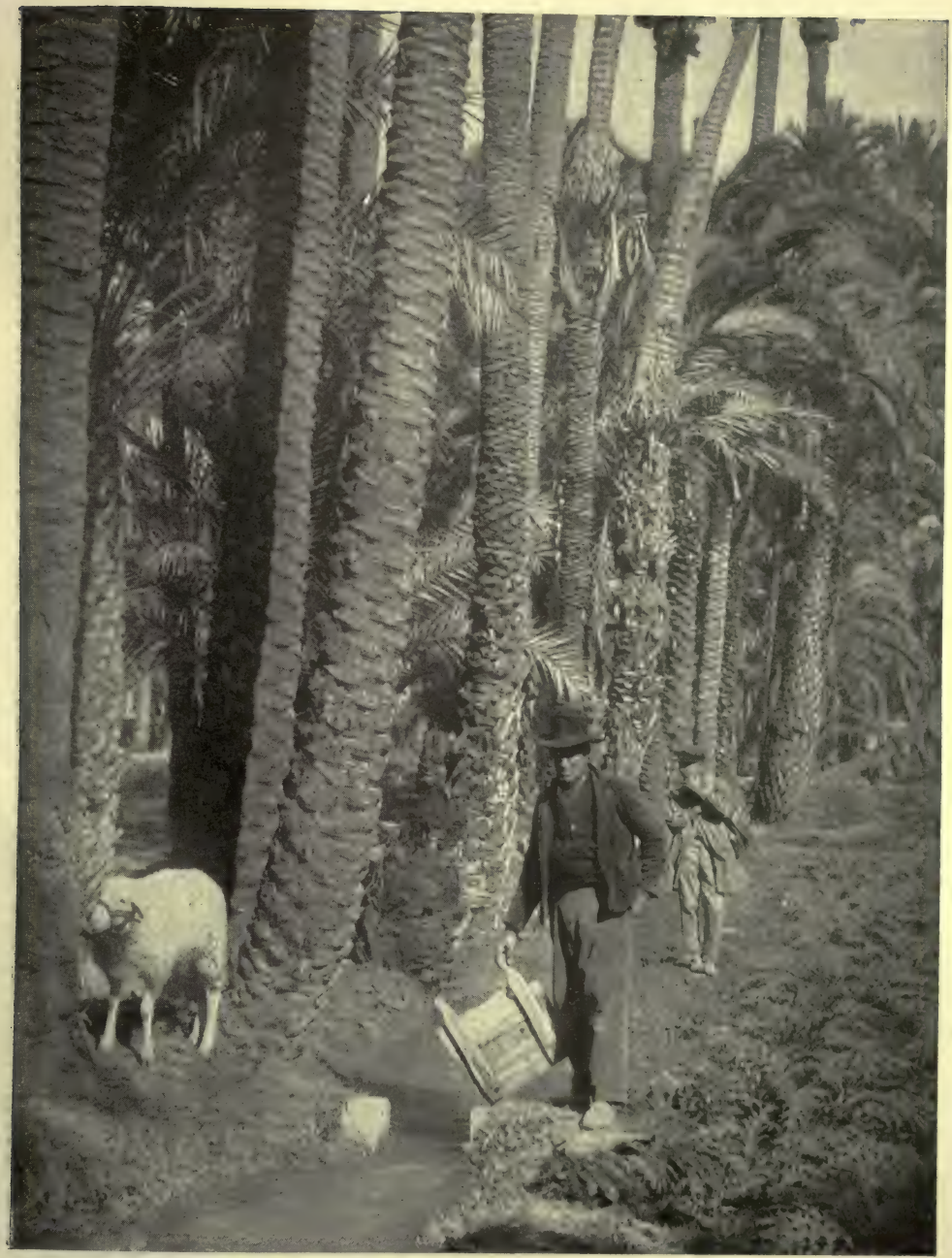


Photo and Copyright by Underwood & Underwood

HOW THE DATE ORCHARDS OF ELCHE ARE WATERED—AN IRRIGATION CANAL AMONG THE FRUITFUL PALMS: SPAIN

Photo and Copyright by Underwood & Underwood

LOOKING ACROSS THE HALL OF THE TWO SISTERS TO THE "WINDOW OF LINDARAXA"

The tall vase in the right hand corner is the "Alhambra Vase," said to have been found full of gold after the flight of the last Moorish king. The figures are dressed in the costumes of the days of the Moorish kings (see page 214).

Photo by Louise Coleman

DANCING GIRLS OF SEVILLE

commercial and manufacturing people, and the country is dotted with cotton mills and factory chimneys.

As one comes from the north, the first important town is Gerona, memorable for the heroic defense against the French a century ago. The besiegers even poisoned the river. The city has several ancient churches, one with an old baptistery beside it, which a utilitarian age has turned into a lumber-room.

Barcelona, Spain's largest and busiest city, is a most attractive place, possessing the best climate in the western Mediterranean—more equable than that of Nice. A stroll along the Rambla, the chief boulevard, is full of interest. This part of it, the Rambla dels Flors (in Catalan, "of the flowers"), is given up for some blocks to flower booths. Just beyond are many-colored birds, twittering away in little wooden cages. One can take a delightful ride on the top of a double-decked trolley car to the Tibidabo, a pine-covered hill overlooking the city and its magnificent harbor.

A few miles down the coast is Tarragona, whose stately aqueduct is a reminder that she was the chief city of Roman Spain. In her museum is an old Roman grain mill, on which a humorous boy once cut in Latin: "Work, little donkey, the way I worked, and much good 'twill do you."

A few hours further south lies Tortosa, on the Ebro, the only large river in Spain emptying into the Mediterranean. Its waters are largely diverted into irrigation canals, which make the fields and gardens a delight to the eye; and the combination of date palms and waving wheat shows what a variety of products the country produces. One can still see on the streets huge jars which remind one of Ali Baba and the Forty Thieves, and in the wine stores wine is sold in pig-

RAMBLA DELS FLORS: THE PRINCIPAL BOULEVARD OF BARCELONA

VIEW OF GERONA (SEE PAGE 193)

skins, calked with pitch, which gives it a taste much like that of the dilute spruce-gum into which wine degenerates in Greece.

Turning inland one is soon met by the strangely toothed ridge of the Montserrat (about 4,000 feet high). This was the traditional home of the Holy Grail, and its monastery is a famous pilgrimage spot. A cog-wheel railway makes the trip an easy one. Cultured Benedictine monks still dwell under those tremendous cliffs, but their artistic treasures were looted by the French, who have several times found Spain a convenient gold and silver mine. The mountain is endlessly beautiful, with its views over to the Pyrenees and its wealth of vegetation. Its spring flowers are largely of blue color — violets, hepaticas, flax, larkspurs, hyachinths, and many others.

THE COMBINATION OF DATE PALMS AND WHEAT FIELD SHOWS THE VARIETY OF PRODUCTS

Now the train labors up to the bleak highlands of Castile, bare and forbidding. Central Spain is a high plateau, crossed by rugged mountains, scorched in summer and frozen stiff in winter. The Castilian farmer, too poor to purchase fertilizers or drill wells for irrigation, generally leaves the land fallow every other year. Then it seems a barren desert, and one is constantly struck with the contrast of the green wheat-fields on the strips under cultivation.

Here and there shepherds accompany their heavy-fleeced merinos, nibbling even as they cross ploughed land. The good-natured herdsmen, with their rough coats and skin trousers, have not much changed since Don Quixote's day, when the *mesta*, the sheep-owners' corporation, was as despotic as any western ranchers' association. Literally millions of sheep used to be driven across the country in the change from summer to winter pasture; they cropped close all vegetation—Spain's lack of forests is partly their fault—and the *mesta* was legally entitled to the hundred yards each side of the roadway for the sheep to graze upon. It is less than a century since the corporation lost its monopoly and the farmer got his rights.

Seeing León's massive Roman walls and towers, one can easily believe that its name comes from the Roman legions once quartered here. The high church tower in the background is of Saint Isi-

THE ROMAN WALLS OF LEON, SAINT ISIDORE (SEE PAGE 195)

AN OLD BAPTISTRY AT GERONA, NOW USED AS A LUMBER ROOM

THE RUINS OF A ROMAN AQUEDUCT AT TARRAGONA, WHICH WAS THE CHIEF CITY OF ROMAN SPAIN

THE REMAINS OF ANOTHER ROMAN AQUEDUCT: MERIDA (SEE PAGE 205)

ALI BABA JARS AT TORTOSA (SEE PAGE 193)
It was in jars like these that Ali Baba concealed his Forty Thieves

COG-WHEEL RAILWAY UP THE MONTSERRAT (SEE PAGE 195)

THE MONASTERY OF THE MONTSERRAT (SEE PAGE 195)

Photo by Louise Coleman

THE PUBLIC FOUNTAIN IN A SPANISH TOWN

dore; the saint's relics were brought here in 1063 by Ferdinand I of Castile and León.

At the end of the main street, with its lively groups and here and there an ox cart, is the famous cattle market. The mouse-colored oxen are short-horned and much like ours; they are yoked by the horns; skins are used to keep the yoke from galling. In another part of the town a general market is held Saturday mornings. The square is crowded with booths and with peasants buying and selling. The section devoted to local pottery is especially interesting. The peasants dress largely in homespun—they still practise the household arts in Spain. The men wear knee-trousers, and one sees here, as in many parts of Spain and our own Southwest, the *alpargatas*—low canvas shoes with hempen soles.

The Guadarrama Mountains, running across the Castilian tableland, overlook the Escurial, Philip the Second's imposing palace. This was his hobby; to it he devoted millions of dollars, at a time when he was often at his wit's end for money. In its wild, rocky surroundings the enormous pile is extraordinarily impressive. Within, one is shown the funeral niches where rest the kings and queens of Spain, and the chamber where Philip himself died of a loathsome and lingering malady.

More interesting, perhaps, is the wonderful collection of manuscripts. In spite of disastrous fires, the Escurial remains one of the world's great libraries. Many of the manuscripts are illustrated. In one we see our first parents, as a tenth-century Spanish monk pictured them; they eye one another with recriminatory glances; but the serpent, twined about the tree, leaves no doubt who was guilty. Another manuscript, written in 1047, has as its frontispiece the Cross of Oviedo—the Christian symbol in the

SHEPHERDS AND THEIR FLOCKS OF MERINO SHEEP IN CASTILE

MOORISH BRIDGE AT CORDOVA (SEE PAGE 205)

CASTLE OF SAN SERVANDO: TOLEDO

THE ESCURIAL, BUILT BY PHILIP II (SEE PAGE 200)

CROSS OF OVIEDO: ILLUSTRATIONS FROM OLD MANUSCRIPTS IN THE ESCURIAL

OUR FIRST PARENTS AND THE SERPENT AS PICTURED BY A SPANISH MONK OF THE TENTH CENTURY (SEE PAGE 200)

fight against the Saracen—with Alpha and Omega hanging from it.

Madrid is a well-built, modern city with busy offices and bustling trolley cars. Like our own capital, it is an artificial city, depending upon the government, tourists, and society for its subsistence. Its picture gallery, in the Prado, is the peer of any in the world, and must be visited by students of Titian, whose paintings here preserved rival those of Velasquez in beauty and interest.

A greater attraction to the populace is the huge bull ring, seating nearly 15,000. On Sunday afternoons a gay throng gathers there; the bull-fighters march out in their brilliant costumes, and the ceremony of slaying the bull begins. It is almost a ritual, and every detail must be punctiliously observed. First, the bull is made to charge the horsemen, the *picadores,* who jab him with short-pointed spears; the horses wear a blinder over one eye, so that their rider can keep them from seeing the bull's onset. If they are not killed at once when the bull gores them, they are sewed up and made to meet another attack. This is the revolting part of it. After enough of this, nimble *banderilleros* throw their darts into the creature's neck and shoulders at just the proper place and interval. These men, and the *espadas* who follow them, show great dexterity and grace. The *espada* is a seasoned bull-fighter; his function is to plunge his rapier into the bull's heart, and his calmness as he maneuvers the beast into a favorable position, teasing him the while, is fascinating to watch. The audience, with eyes keen as hawks', applaud every good stroke, and hoot in derision at any misplays.

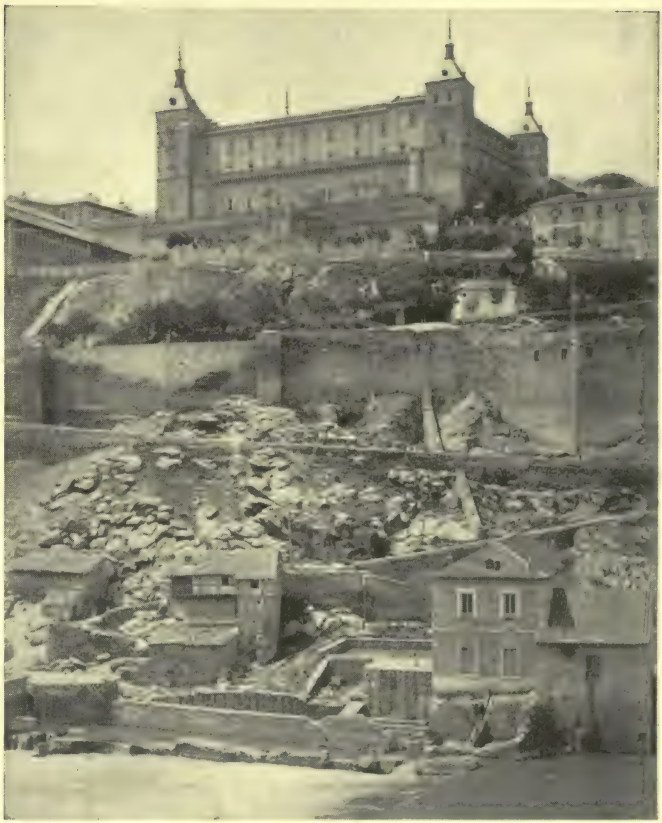
The net influence of the sport is demoralizing, and much of the best element in Spain is against it, unless it can be

PUERTA DEL SOL: TOLEDO (SEE PAGE 205)

GATE OF PARDON: SEVILLE (SEE PAGE 208)

reformed; but the same can be said of our present form of football, and the one is as likely to disappear as the other. The same arguments are heard in Spain in favor of bull-fighting which are used here for football—it makes the participants brave, alert, quick to act and to help out a fellow-fighter; but at least the bull-fighters maul only animals, not their fellow-men. A Spaniard considers the latter brutal.

Not far from Madrid lies Toledo, the ancient Visigothic capital. The Tagus flows about it in a deep gorge on almost every side. High above the old mills looms the Alcázar, the one-time castle, now a military school. Toledo is a fascinating city, with narrow, winding streets, and shops where one can still buy Toledo blades, tempered in the Tagus, and inlaid with gold. Down its widest street, in which two carts can actually pass, rises the great Gothic spire of the cathedral, which replaces the Moorish mosque. The main square, the Zocodover, keeps the Arabic word *zuq* (market) in its first syllable; one of the Moorish gates, the Puerta del Sol, of 1100, is still intact; and in the Casa de Mesa are beautiful Moorish arabesques and tiles, nearly 500 years old.



THE ALCAZAR OF TOLEDO, ONCE A FAMOUS CASTLE, NOW USED AS A MILITARY SCHOOL

Beside the city shepherds drive their parti-colored flocks along the highway; above rises what is only too truly a type of "castles in Spain"—the dismantled fortress of San Servando.

A day's journey to the southwest lies Mérida, once a Roman metropolis. It still possesses Roman bridges and its ancient theater, and outside the city are still standing several arches of the old Roman aqueduct—"Los Milagros" (the miracles) they are called by the peasants, and it is a miracle that this arcade remains, after so many centuries of earthquakes and invasions. On top of the aqueduct storks, sparrow-hawks, and black-birds nest together in apparent amity.

At Cordova one enters southern Spain, with its highways bordered with aloes and prickly pear (both American importations, like tobacco, maize, and potatoes), and its groves of olive trees. Spain leads the world in the production of olive oil; but it is mostly refined for export in France and Italy; Spanish wines are also largely altered abroad for the consumer's palate. One of Spain's

IN MADRID

Photos by Louise Coleman

THE MILK-DELIVERY SYSTEM OF GRANADA

A SPANISH BOY

ANOTHER SPANISH FOUNTAIN

Photos by Louise Coleman

THE FOREST OF PILLARS IN THE MOORISH MOSQUE AT CORDOVA

great needs is capital and enterprise to elaborate these products at home. She has cheap and willing labor, as our Vermont quarries can testify; Barre and Montpelier are full of Spanish workmen.

Cordova lies on the Guadalquivir, here crossed by a Moorish bridge on Roman piers; the Moorish keep is still preserved. A thousand years ago Cordova was the intellectual and artistic center of western Europe; its university drew students from everywhere, and its products, especially leather (cordwain, *i. e.*, Cordovan), were famous. Today its narrow and sunny streets, with their picturesque churches, seem deserted; but the cathedral chapter has preserved one memorial of past magnificence in the Moorish mosque, the greatest Mohammedan building west of Mecca. Entering its precincts by the Orange Court, one finds the portal flanked by two Roman milestones. With exquisite taste the canons have set to the left one dating from the year of Christ's birth; to the right, from that of the crucifixion. Thus they typify Christianity's conquest of both the Roman empire and Mohammedan Moor.

The mosque itself is a forest of pillars, which divide the huge, low building into a score of naves. There are over 900 of these columns; some were sent here even from Constantinople, mates, perhaps, of those sent at the same time to Charlemagne for his palace at Aix-la-Chapelle. Those were the days of Haroun-al-Rashid and the Arabian Nights; but the splendor of Cordova rivaled that of Bagdad. Abderrahman's wonderful palace—far more sumptuous than the Alhambra, to judge from the descriptions of the Arabic historians—has perished utterly; but the mihrabs, or prayer niches, in the mosque give some idea of the beauty of Cordova at the height of her glory.

Descending the Guadalquivir, one feels the Moorish presence on all sides. The men who sit idle in the market-place, the women who bring their graceful jars to draw water, often have strongly Moorish features, and with good reason, for the Moors held the kingdom of Seville for over 500 years.

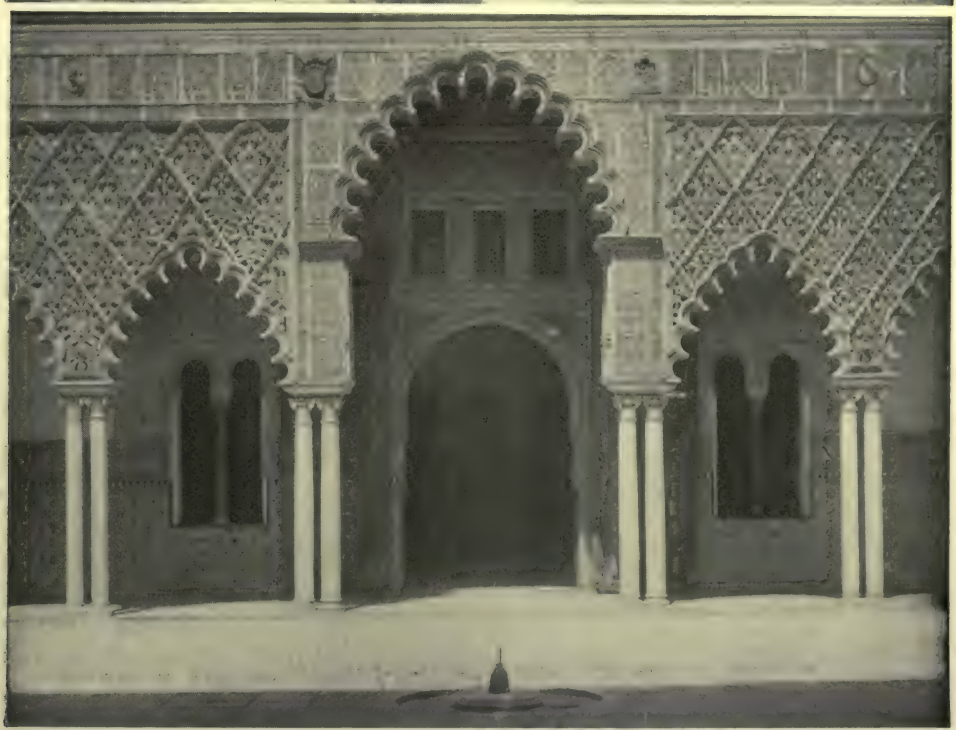
The proudest memorial in Seville is the lofty Giralda, once the muezzin-

MOORISH TYPES
AT A WAYSIDE TROUGH

THE GIRALDA: SEVILLE (SEE PAGE 208)

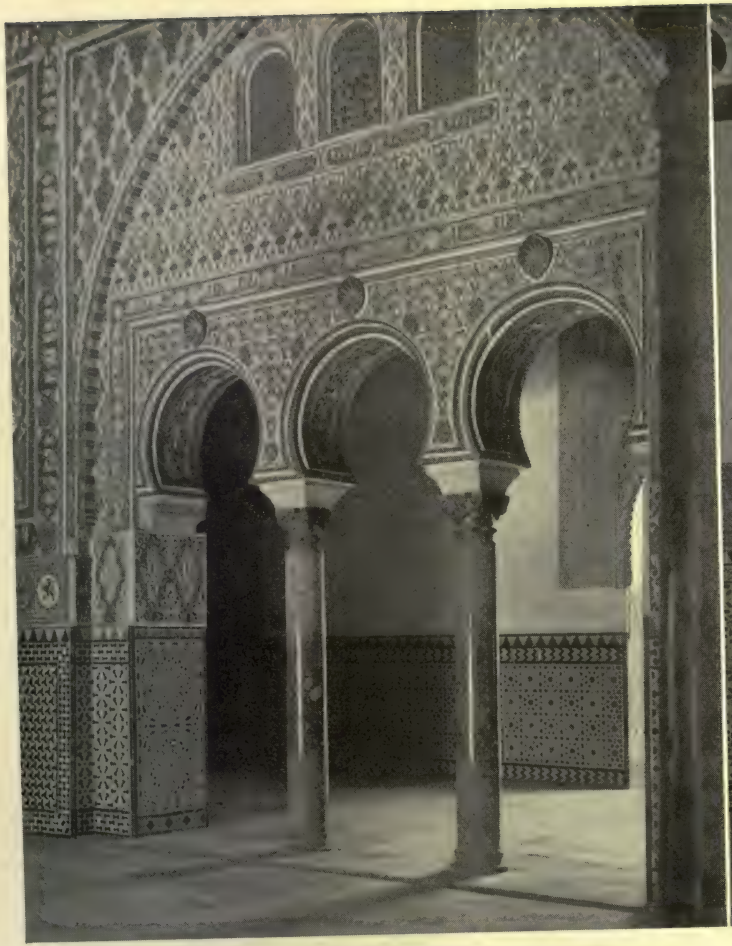
tower of the mosque. Finished in 1196, it rises 300 feet above the street. The ascent is easy, up a corkscrew inclined plane, and the view down upon the massive cathedral and over the city and plain is most impressive. The great bells swing and clang from time to time, scaring away the myriads of little sparrow-hawks which make their home here. The Orange Court of the cathedral keeps its Moorish Gate of Pardon; but the mosque, which vied with that of Cordova, was razed to make room for the noble Gothic cathedral.

Not far away, however, the Moorish Alcázar is still preserved as a royal palace. Though built by Christian kings of Castile, its architects were Moors, and they employed all the delicate refinements of their art. Standing in the Court of the Damosels, where Charles V married Isabella of Portugal, one can hardly be-

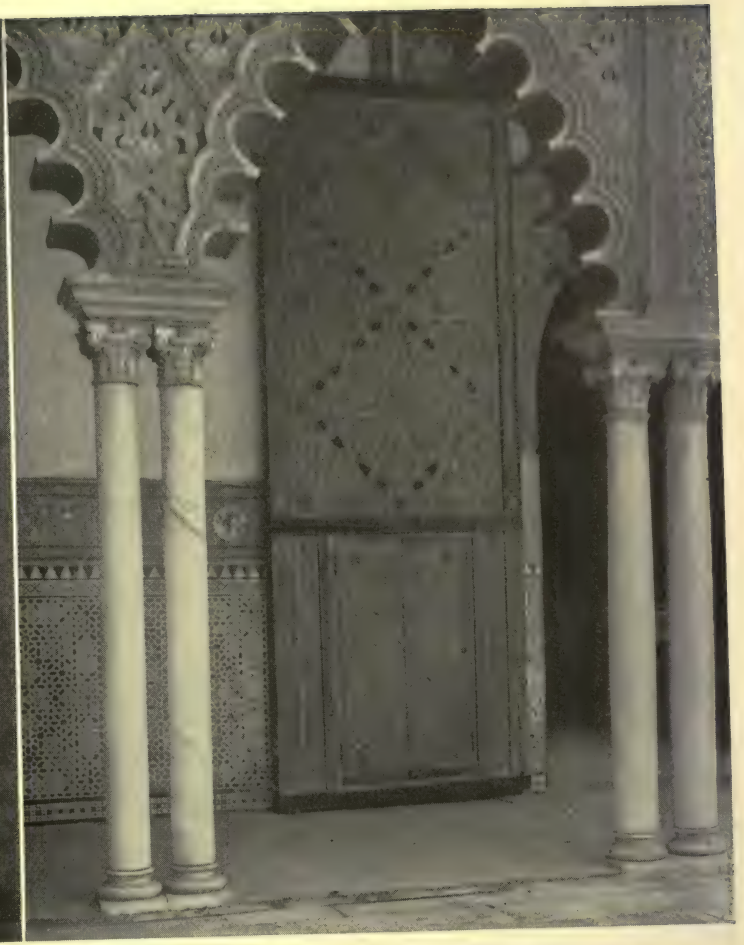


UP THE DARRO VALLEY: GRANADA

COURT OF THE DAMOSELS: ALCAZAR, SEVILLE



SALOON OF THE EMBASSADORS: ALCAZAR, SEVILLE



A DOOR IN THE COURT OF THE DAMOSELS

HIGHWAY ABOVE CORDOVA LINED WITH ALOES AND PRICKLY PEARS

STAGE-COACH: SAN FERNANDO TO ALGECIRAS

SPANISH CHILDREN

lieve that this stone lace-work is merely a stucco cement, molded and fastened upon wood. Very beautiful are the dados of enameled tiles, or *azulejos,* and the folding doors are marvels of Arab carpentry. The horseshoe arcades of the Saloon of the Embassadors are the most graceful and ornate in Spain.

Granada, long a decaying provincial city, is now alive with trolley cars and electric lights, and tourists are so common here that the small boys have even learned a few English words with which to coax away small coin. But the herds of goats, and an occasional cow—an economical milk-delivery system — give a pastoral touch to the town. One sees the same thing at Naples, and the Neapolitan milkman has even discovered a unique way of increasing profits. Under his coat he puts a hot-water bag, with a long rubber tube running down his coat sleeve, and, as he milks, he injects into the pail that percentage of *aqua pura* which milkmen of all ages and peoples have found desirable.

Granada lies at the point where the Darro and the Xenil, running down from the mountains, unite as they enter the fertile plain of the Vega. Above the city rise the foothills—one crowned by the Alhambra — and beyond them the snow-capped ridges of the Sierra Nevada, 10,000 feet higher. Granada has, therefore, a singularly beautiful situation, and it enjoys a mild and agreeable climate. The romantic interest of its history completes the spell. Here was the last Saracen court in western Europe; here Isabella of Castile, with the money loaned her by a Spanish Jew, financed the Genoese adventurer's foolhardy quest; here Ferdinand and she, in that same momentous year of 1492, decreed the expulsion of the Jews from Spain; and here their ashes now repose, in the great Renaissance cathedral which they built in gratitude for their triumph over Islam.

Strolling first up the Darro Valley, between lines of whitewashed houses, glaring in the spring sun, one soon reaches the gypsy quarter. These nomads, whom George Borrow sketched so intimately, have settled here in cave-dwellings among the aloes and Indian figs, and issue forth to meet the tourist with guitar and invitation to a dance. Beyond lie bare hills, from which a wonderful view may be gained.

The Alhambra looms up over the valley, commanding the city and the nearer plain; like the Parthenon, its strategic value led to its undoing. But, ruinous though it is, the Alhambra remains the best western reminder of Saracen culture and magnificence. Its Myrtle Court, with a sunny pool, leads to the main enclosure, the Lion Court, off which open the gorgeously decorated rooms which Irving has immortalized. Every detail is worth noticing; the dados, with their varied tile designs; the ornamental friezes, in which verses, often from the Koran, border intricate arabesques; the beautifully fretted arches and the delicate Moorish windows. What remains is so exquisite that one hardly dares imagine its original grandeur.

The trip from Granada to Gibraltar is now easily made by railway; but no one

knows Spain who has not taken a stage ride over its breezy plains and aromatic hillsides. The ride from San Fernando, near Cadiz, to Algeciras, across the bay from Gibraltar, is a fascinating experience. Relays of four or five horses rush the coach along over good roads at a steady trot, below Moorish wind-mills, past ruined castles, and beside wide marshes, where storks, cranes, herons, flamingoes, and wild fowl watch its progress. Everywhere the perfumed breeze pursues it, under the brilliant blue of the southern heaven. Now it skirts the seashore, looking over the strait to the forbidding African mountains; now it toils up bleak hillsides, brilliant with the yellow of the fragrant broom. "Pepe," the driver, handles the clothesline reins for all the 60 miles; his postilion occasionally hurls a stone artistically at one of the leaders, to bring him to reason; but in general Pepe drives with his voice, bestowing encouragement and malediction at the top of his lungs upon each of the horses by name; and better driving it would be hard to find.

At the relay stations, a half dozen in number, there are waits of 20 or 30 minutes, in which one can stroll about, watch the larks and countless other songsters, and pick the tiny blue irises and other charming wild flowers. As the coach carries the mails, it is constantly accompanied by one or more civil guards, as the Spanish gendarmes are called. In their striking hats, they are remarkable figures, especially in combination with the herdsboy, whose sheep and goats are browsing under the olive trees.

This ride has an added charm in its historical associations. Within a mile or two of the road are the battle-fields of the Salado, where the Visigoths vanquished the Vandals, in 417, and drove them over to Africa, and where, also, in 1340, Alfonso XI defeated the Moors, in the first battle in Europe, it is said, in which Damascus cannon were used. Near by is the Laguna de Janda, where, in 711, the great battle began in which the Moors won Spain from Roderick and his Visigoths. One of the stops is the picturesque city of Tarifa, where Guzman el Bueno saw his own son slain before his eyes rather than give up the castle to a traitor; and from Tarifa's Alcázar one can see Trafalgar, off which England won the empire of the seas. As the stage, after passing the Moorish aqueduct, draws up at Algeciras in the early evening, the search-lights from "the Rock" remind one again of the consequences of that battle.

"Quien dice España, dice todo"—he who says Spain, says all. And, indeed, Spain has everything, from snow-clad peak and wind-swept *mesa* to fragrant orange groves and waving palm trees. If the traveler comes to her to learn, she sends him away richly rewarded, and her austere charm will surely draw him back.

A NEW NATIONAL PARK

By Guy Elliott Mitchell, U. S. Geological Survey

THE nation that leads the world in feverish business activity requires playgrounds as well as workshops, says George Otis Smith, which is but an application to America of the old saw that all work and no play makes of Jack a dull boy. When Secretary Seward was endeavoring to enlist the support of the people for his project to purchase Alaska one of the somewhat æsthetic arguments by which he sought to gain advocates was that this great northwestern territory should be acquired if for nothing else than that it would afford a magnificent summer playground for the American nation. Alaska's purchase is doubtless justified on this score alone, and, while its varied topography affords in truth a wonderful field to the tourist, there are much more readily accessible

"playgrounds" within the United States. Indeed, some lie at our very doors, although for lack of good transportation facilities they may be more difficult of access than far distant points.

The nation owes it to itself, to the people of the present day, and even more to those of a future congested population to create into national parks the magnificent regions of the Rocky Mountains and the High Sierra, which have little, if any, economic importance, and thus preserve always their natural, wholesome beauties. Transportation methods will quickly follow and thus new "playgrounds" become accessible.

A NATIONAL PLAYGROUNDS ASSOCIATION

A national playgrounds association for grown-ups, organized on some such basis as that of the Sierra Club of California, but with the United States for its field of activities, would find important work to be done and would enlist many ardent supporters. Numerous national parks have already been established by the government, some because of their recognized standing as natural wonderlands, such as the Yellowstone, and others through insistent championship of enthusiasts.

The youngest member of the playground family, now knocking at the door for national protection, is the proposed Glacier National Park in northern Montana. There are some people in the East who do not even know that there are glaciers in the United States today, but think of them as extinct monsters belonging to a past geologic era. To such the very name, Glacier Park, is an education. There are no longer, it is true, vast continental glaciers; even the great frozen regions of Alaska are small in extent compared with the ancient glaciers, but the remnants of the one-time universal ice-sheets, such as can be seen in Glacier Park, are so majestic and numerous as to awaken in the mind of the traveler sentiments of unbounded awe and wonder at Nature's matchless handiwork.

"Give a month at least to this precious reserve," says John Muir, some ten years ago, in speaking of the delights of this region. "The time will not be taken from the sum of your life. Instead of shortening it will indefinitely lengthen it and make you truly immortal."

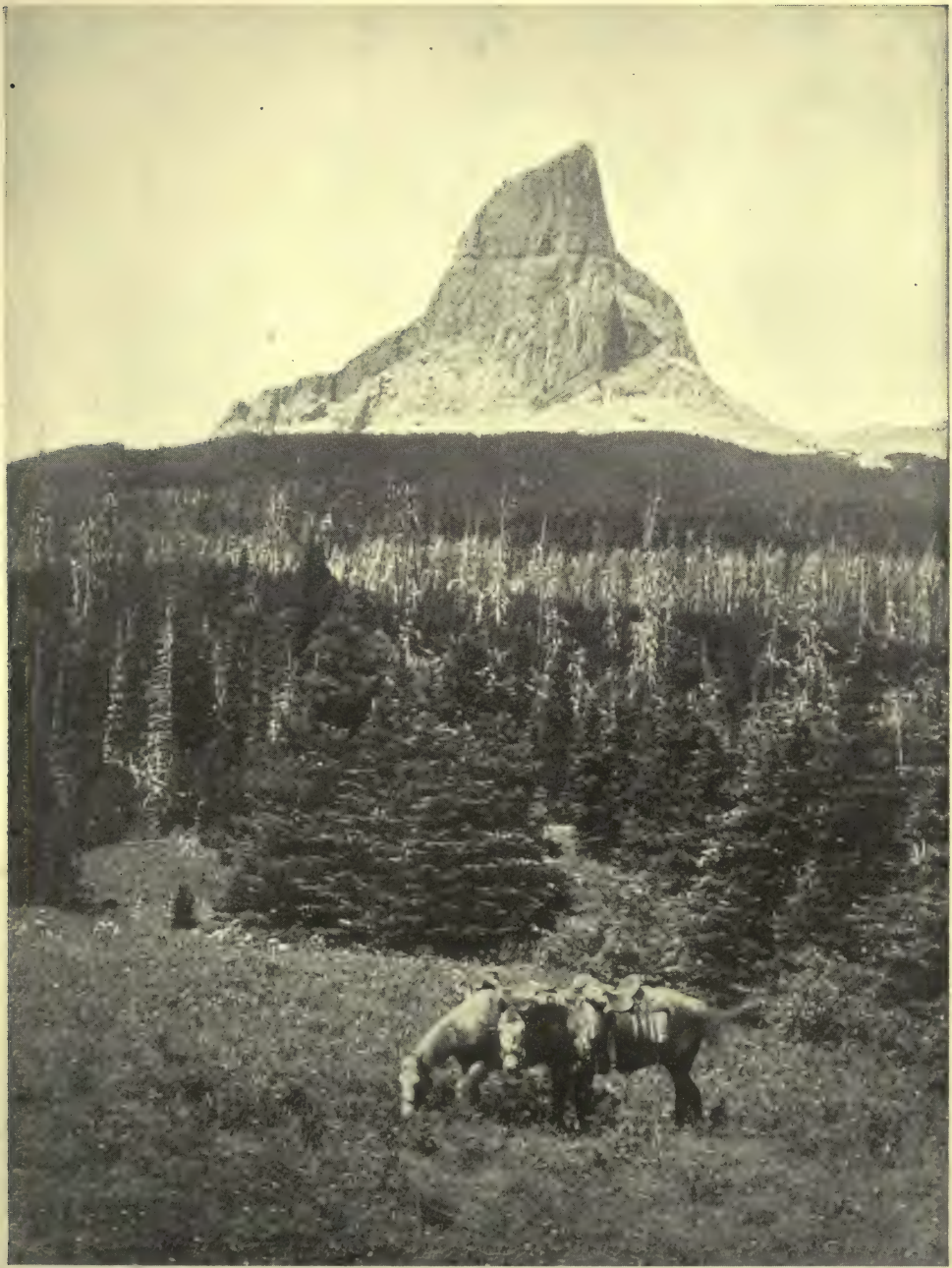
Nor are the attractions of the Glacier Park region confined to the scenic. Here lies, for instance, the majestic Lake McDonald, full of brisk trout, as described by Mr Muir, in the heart of the splendid Flathead forests of giant pine, spruce, and cedar, while 10 miles above is Avalanche Lake, shimmering at the foot of a group of glacier-laden mountains. Far up the white peaks one can hardly fail to meet the white goat or American chamois, while in other retreats dwell deer, elk, and bear and many smaller, sleek-furred animals enjoying their beautiful lives in company with numerous bird species.

It is hoped that the present session of Congress will preserve for the nation this latest playground and constitute it another of our national parks. It will then be our second largest park, surpassed only by the Yellowstone.

FAVORABLY REPORTED IN CONGRESS

The Sixtieth Congress made a favorable report on a glacier park bill, which had also the strong support of the Secretaries of the Interior and Agriculture. This report was based largely upon a topographic survey made four years ago by a United States Geological Survey party, and upon a later compilation by Robert H. Chapman, one of the party, embracing a total area of about 1,000,000 acres lying just south of the Canadian line and between Flathead River and the Blackfeet Indian reservation. This area contains 60 or more true glaciers, ranging in size from small glaciers of a few acres each to those covering 5 square miles. It also contains over 250 glacial lakes from a few hundred feet to 10 miles in area.

The Rocky Mountain system in the United States abounds in regions of wild and magnificent scenery, but it is doubtful if any of them surpasses in grandeur



CHIEF MOUNTAIN, 10,000 FEET ABOVE THE SEA: A LANDMARK FOR AN EXTENSIVE AREA OF THE PLAINS

It is a turning point in the boundary between the Blackfeet Indian Reservation and the Forest Reserve

GOATHAUNT PEAK: A SPUR OF MOUNT CLEVELAND, LEWIS RANGE
A 2,400 foot vertical limestone cliff. Goat trails extend across the cliff face

and interest that of Glacier Park. From its area water flows to Hudson Bay, the Gulf of Mexico, and the Pacific Ocean. Mount Cleveland, its highest peak, reaches an elevation of 10,434 feet, and there are many other rugged mountains ranging from 6,000 to 10,000 feet above sea-level. This area of the Northern Rocky Mountains, says Mr Chapman, which lies to the north of the Great Northern Railway and to the south of the Canadian boundary, is one of the most beautiful mountain regions in the world. Approaching the divide from the plains region to the east, the mountains present to the traveler a rock wall of great steepness extending northwest by southeast for unbroken miles except where cut by deep U-shaped canyons. These have been largely formed by the great glaciers which once slowly flowed from the mighty snow-covered peaks and ridges forming the divide between the drainage of the Atlantic and the Pacific oceans—the northern Continental Divide.

THE WHITE MOUNTAIN GOAT

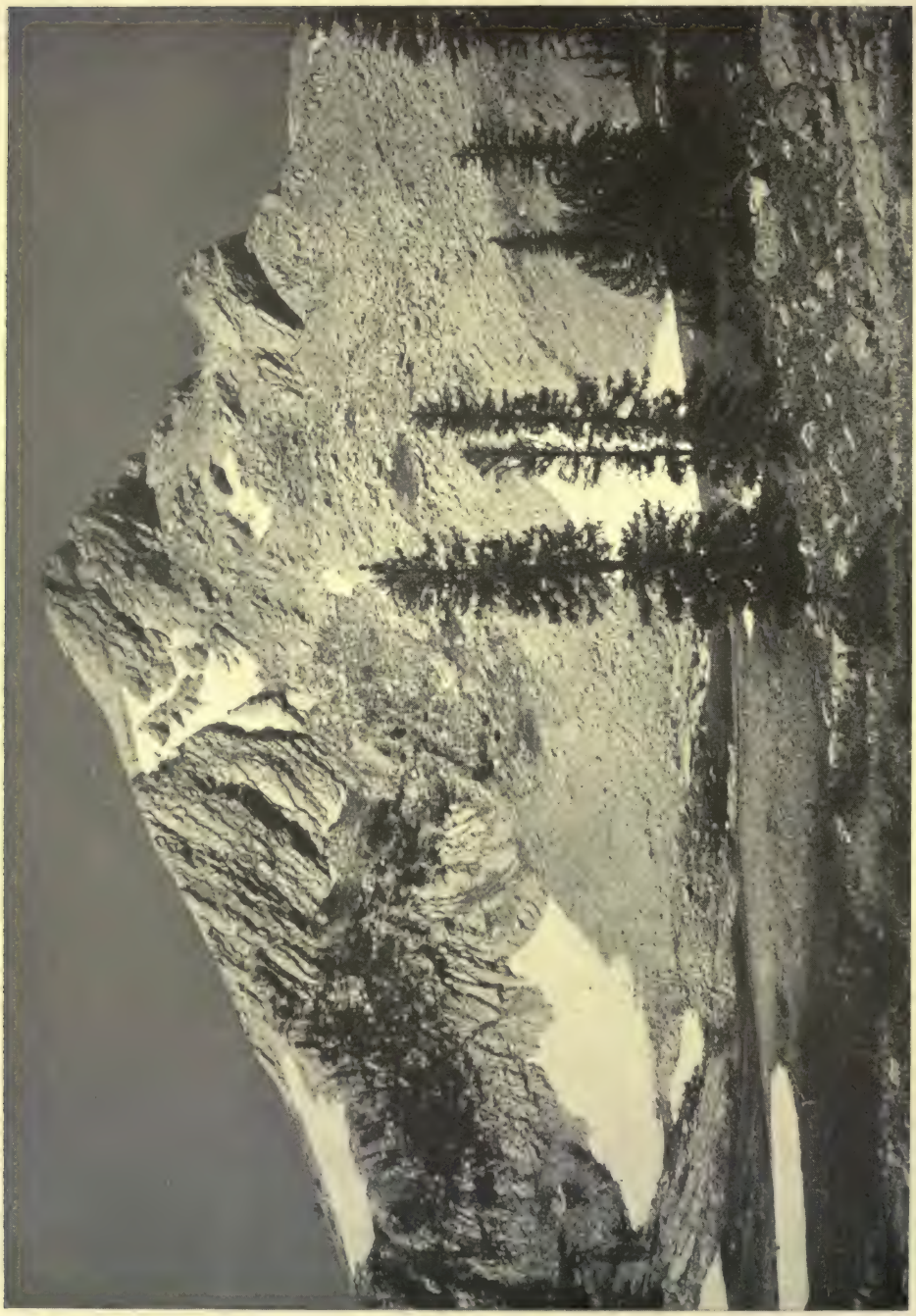
An animal delighting in the most rugged topography; yet in the greatest danger of extermination, unless protected in its natural breeding places.

FED BY GLACIAL ICE

Deep in the canyons are roaring streams, coming from the melting ice and snow and flowing into placid mountain lakes and thence into the arroyos of the plains below. Between the canyons the long finger-like ridges rise to considerable heights, the timber-covered slopes ascending steeply until a region of brush-grown broken rock is reached, which in turn leads to the base of precipitous cliffs. The canyons at the head usually terminate in great amphitheaters, rising cliff over cliff in a stairway of tremendous proportions. Many of the steps of these giant's stairways retain ice masses which slowly flow across them, each fed from a large ice mass above until a region of huge snow-banks is reached.

The main Rocky Mountain mass is actually made up of two principal parallel ridges, the Lewis and the Livingston ranges, which run approximately through the center of the proposed park. These ranges are the remnants of what was once a much wider plateau-like region of rock, which, however, has been mightily carved and shattered by the forces of erosion, principally those of the great ancient glaciers. Resting upon this great mass are the higher peaks, huge pyramids and blocks, with cliffs and precipices of hundreds and sometimes thousands of feet, plunging away down to the roaring streams of the canyons, or ending in the great crevasse at the head of some glacier.

To the westward the mountains break precipitously, and from the foot of the steep, long, timber-covered ridges reach out toward the valley of the Flathead River. Between these ridges and extending up the canyons of the higher range are many miles of lakes, joined by rushing streams similar to those on the eastern side.



THESE GLISTENING, BARREN PEAKS, ALMOST AS WHITE AS THE SNOW BANKS WHICH COVER THEM, IN PLACES RISE FROM A PLATEAU WHICH IS ITSELF ALMOST AS BARE

MISSION RIDGE, MONTANA: GEOLOGICAL SURVEY TRIANGULATION PARTY
In high mountain regions, October snows are likely to be from two to four feet deep

THE PARADISE OF BIG GAME

The whole park is inhabited by wild animals and birds, and the streams and lakes abound in many kinds of fish. In the higher barren rock areas the white goat is found in great numbers, while on the slightly lower ridges, where some protection is afforded by stunted timber growth and brush and jagged slopes, the Rocky Mountain sheep, or "bighorn," has his haunts. In the valleys and on the lower spurs are many white-tail and black-tail deer and moose; in places a few elk are found, and over the whole area, from high glacier and snow-field to huckleberry-bush region of valley and flat, roams the giant grizzly bear.

All the game animals use the higher mountain districts for summer range only, as the area is too high and the snowfall too heavy to permit of winter use. As in the case of the other national parks, these game animals, protected by law from interference, will increase to such an extent as to furnish in the overflow from the park a tempting supply to sportsmen for all time; on the other hand, without such protection of a breeding ground, many of the animals, especially the bighorns and the white goats, will soon become practically extinct.

There are numerous passes through the higher ranges. Across these the game trails lead from valley to valley. Following the game came the Indians; the hunter and the trapper, looking for easy routes of travel, followed the Indians; then came the government engineers exploring and mapping, and finally the hardier of the tourists and lovers of nature. Most of these passes are closed for many months of each year by snow; some of them are available only after the use of the axe to give footing on the hard ice of glaciers lying close to the Continental Divide, but across one or two of them wagon roads may be built by

"HEAVEN'S FOLD"

Distortion of Algonkian strata, as seen from Mount Heavens, Livingston Range. From snow bank at base to summit of peak is over 2,000 feet

which persons unfitted for the strenuous efforts now required to reach the higher country may have opportunity to view it at close range. None of the passes that are south of the Canadian boundary will ever be used for a railway route.

There is interest in Canada which looks with favor upon the creation of the proposed Glacier Park, and at some future day the locomotive may cross from the Dominion to the waters of the Flathead River and wend southward to the towns and farming valleys adjacent to Columbia Falls and Kalispell, forming a link between the Canadian Pacific and the Great Northern railroads. A route on the west side of the Flathead River, says Mr Chapman, is very available for the location of a railroad track.

In order to open this region of superb and unique scenery for the public, a few main roadways will be required along the streams, together with horse trails to points of especial interest. Lake McDonald, it is pointed out in the Senate report, lying near the southwestern boundary of the proposed park, is a sheet of water of unmatched beauty, surrounded by scenery of such signal grandeur as to make a roadway along its eastern shore extremely desirable, but this, it is stated, is a matter for the future consideration of Congress.

AN IDEAL NATIONAL PLAYGROUND

The region combines all the elements of an ideal "playground" as it stands. It needs only official designation to insure its protection and perpetuity as such to stimulate the establishment of transportation facilities, making it more readily available to visitors. While of interest geologically, it is of little, if any, economic importance. The conditions are particularly adapted to the study of the structure and history of mountain building, as the ancient forces of nature were most active and a tremendous folding and warping of the once horizontally bedded rocks is in many places apparent. At one time prospectors for copper flocked to the region, but no finds were made indicative of any economic deposits, and the same may be said as to oil. From the reconnaissance made by the Geological Survey it is not believed that Glacier Park contains any mineral-bearing formations of commercial importance. However, if such are discovered following the creation of the park there will be nothing to hinder their development.

THE MOST CURIOUS CRAFT AFLOAT

The Compass in Navigation and the Work of the Non-Magnetic Yacht "Carnegie"

By L. A. Bauer

Director of Department of Research in Terrestrial Magnetism, Carnegie Institution of Washington

Illustrations from Photos by Magnetic Expeditions of the Carnegie Institution

A RECENT newspaper clipping brings the following interesting information:

"Mr Carnegie's non-magnetic yacht, the *Carnegie*, which is making sea surveys for the Carnegie Institute, has made the discovery that American charts show errors of three degrees between Madeira and Bermuda. 'These errors,' it is stated, 'could not have been discovered in other than a non-magnetic vessel.' That being the case, what was the good

of discovering them? There is only one non-magnetic vessel afloat, and that is the *Carnegie,* and the 'magnetic' vessels seem to have got along very well in spite of the errors."

This clipping is interesting from various points of view and serves splendidly as a text for what we have to say. The pardonable misapprehension of the reporter as to the purpose of mapping out the earth's magnetic forces, as accurately as possible, gives point to the following quotation from Thomas Hood's amusing essay on "The Ocean":

"The importance of the mariner's compass to the sailor is as well known universally as the utility of the little one-eyed instrument, for which Whitechapel is so famous, to the tailor: but its mode of action and the manner of application must be far less generally understood."

Hood draws the comparison here between the tailor's one-eyed instrument and the compass needle which, because of its antics and "variations," gave the sailors "stitches." And he says:

"The needles have sometimes been fatal to mariners."

At the time of the launching of the *Carnegie,* on June 12, 1909, accounts and explanations of the unique features of this, the most "unattractive" craft afloat, as one paper put it, appeared in newspapers and periodicals, not only in all parts of our own country, but in all civilized regions of the globe. Since then clippings are received almost daily with respect to the work done by the vessel. In view of this wide-spread interest, I have accepted with much pleasure the invitation of the editor of the NATIONAL GEOGRAPHIC MAGAZINE to describe, in untechnical language, the *Carnegie's* work, and to set forth the purposes of her mission.

Let me say first that the name of the institution under which the *Carnegie* is operating is the "Carnegie Institution of Washington," not the "Carnegie Institute," as the reporter has it. The latter is located in Pittsburg, and is an entirely different organization.

HOW DO WE TELL THE NORTH?

From early childhood we are taught that, if we face the north, then our right hand is pointing eastward. But suppose we were suddenly transplanted to a region utterly unknown to us, and where a dense cloud covered the sun by day and the stars and moon by night. How could we tell then which direction was northward? This is precisely the problem the mariner has set before him on the trackless seas when the skies are overcast with heavy clouds, completely shutting out all view of celestial bodies.

Fortunately there is one natural agency — independent of wind and weather, night or day—which comes to our rescue, and upon which the navigator, in spite of its so-called "fickleness," has come to rely, namely, the earth's magnetism, by whose subtle power a definite direction is imparted to a delicately poised magnetized bit of steel. Take a compass needle, such as can readily be purchased for a mere trifle and is often found inserted in watch charms; hold it on the table, where it will not be exposed to jarring. When the needle has come to rest, note its direction, then draw it aside by bringing sufficiently close to it a pocket knife or any other article of iron or steel; next, quickly remove the article. The needle swings back and forth, first through a large arc and then through a gradually diminishing one, until finally it comes to rest; if the proper precautions have been taken this position will be found identical with the first. Repeat the experiment and once more, after various oscillations back and forth, the needle settles down to the same direction as before. Why is this?

Sir Isaac Newton, from seeing the apple drop, concluded that the cause of this "phenomenon" was to be referred to the "force of gravitation": the earth "attracted" to itself the apple. And were we to suspend a heavy mass, from the ceiling, let us say, it will hang in an invariable direction—the vertical, or that shown by the plumb-line. Draw the mass aside, then release it. It swings

VIEW OF THE NON-MAGNETIC YACHT "CARNEGIE" AT FALMOUTH, ENGLAND

back and forth just as did the magnetic needle, and, when it comes to rest, it again hangs vertical. The force which was in operation during this experiment was precisely the same as that acting on the falling apple. Is this also the force which acted on the swinging compass needle? No, because the latter was moving to and fro in a horizontal plane, and gravity only acts in a vertical direction.

THE MAGNETIC DIP NEEDLE

Suppose we were to take now a "dip needle," such as was used for the first time by an ingenious and painstaking English instrument maker, Robert Norman, in 1576. This needle is so mounted that, instead of being able to swing in a level plane, it swings in a vertical one. Norman discovered that no matter how carefully he had balanced the needle before it was magnetized, after touching it with the lodestone, so as to magnetize the needle, then there was no longer a perfect balance, but "that presently the north point thereof would bend or decline downwards under the horizon in some quantity." He at first thought that, in spite of his care, he had overweighted the end that dipped below; however, upon repetition of the experiment, he invariably found the same result, and thus was discovered the so-called "dip of the magnetic needle." If the two ends of the magnetized needle are precisely equal in weight, and still the needle won't remain level after magnetizing, then evidently we must have some other force acting than gravity. And the mystery increases, for, if we use a brass needle instead of a steel one, no matter how much we stroke it with the "magnetizing irons," it persists in remaining level.

Evidently we are dealing with a force different from that acting on a falling body. While gravity affects all substances alike, magnetism affects but a

THE SCIENTIFIC STAFF AND CREW OF THE "CARNEGIE" ON THE CRUISE FROM SAINT JOHNS, N. F., TO FALMOUTH, ENGLAND, OCTOBER, 1909

In the foreground is seen one of the two special observation houses in which the instruments are placed. The dome can be revolved and an open panel pointed to any part of the skies, thus making possible both astronomical and magnetic observations, and affording protection from wind and weather.

very few, chiefly iron, steel, nickel, and cobalt. The last two substances respond so feebly to a magnetic force that compasses made of them would be almost as useless as those made of brass. In one other respect magnetic force differs in its action from that of gravity: the force exerted on a magnet is not the same on the two ends—equal in strength and likewise parallel, to be sure, but *opposite* in direction.

If, therefore, as has long ago been concluded, it is the earth itself, as a magnet, which is exerting the force we saw acting on the compass and on the dip needle, then its action is that of a couple. That is to say, were we to float, as Robert Norman did, over three centuries ago, a magnetized needle on a cork in a bowl of water, then, if the liquid is not agitated, the cork will not move from place to place, but simply turn around until the needle points in the direction it occupied at the end of the experiment of vibrations made above.

VAGARIES OF THE COMPASS

If the compass invariably points out some definite direction, where does it point? To the exact north — to the North Star or to the true North Pole? "True as the needle to the pole," the old saying has it, but, alas, considerably far from the truth. In northeastern Maine the compass stands 20 degrees west of north; in the northwestern part of the

BREAD OVEN: GUATEMALA

MOUNTAINEER'S HOME: GUATEMALA

State of Washington 24 degrees east of north; in western Ohio and South Carolina it points either exactly north or nearly so. Taking a trans-Atlantic liner at New York bound for England, the compass continually varies its direction along the entire route traveled, starting out with about 10 degrees west at New York and increasing in the mid-Atlantic to about 30 degrees west, and then dropping to about 17 degrees west at Southampton.

Suppose the earth were an iron ball and it were magnetized symmetrically about the rotation axis, then the magnetic poles would be precisely where

KAIETEUR FALLS, BRITISH GUIANA (741 FEET HIGH)

the true poles are. In this case the needle would everywhere point exactly north and south; or, as the mariner would say, "there is no variation of the compass." The problem of navigation would then be extremely easy: if you wished to go due east, for example, all you would have to do is to set your course east by the compass, and once set it would remain set for the whole cruise.

Assume, now, that the magnetic poles are no longer coincident with the true poles, but are displaced by equal amounts. This case represents an earth uniformly magnetized about a diameter making some angle with the axis of rotation. The magnetic poles are still truly opposite to each other, but, needless to say, a more complicated condition of affairs for navigation is presented. We must now deal with a "variation of the compass," for no longer does the compass point truly north and south. If the mariner knew the location of either magnetic pole, he could readily figure out, for an earth thus simply magnetized, how the compass actually pointed at any place for which the latitude and the longitude were known.

Ralph Walker, of Jamaica, published a book in 1794 in which elaborate tables of the compass direction were given. He believed that the "poles of the ecliptic are the magnetic poles." After exalting the Supreme Architect for having given us this great gift of the earth's magnetism, by which "He enables us to behold

WOODEN PLOW USED IN THE INTERIOR OF GUATEMALA

His works and our fellow-creatures in all the different corners of the world," etc., he goes on to say:

"I hope that I shall be excused for this short digression, it being only the result of my feeling, when I conceived that the longitude might be found by magnetism (with the improvements which I have made upon it) without any trouble or calculation, and with as much certainty at sea as any other way now in use." Alas for Ralph Walker's fond hopes! In spite of his "improvements" upon the Supreme Architect's magnetism, we have not yet been able to find the longitude at sea so simply as he hoped, nor have we been able to make use of his elaborate "Tables of Variation."

THE EARTH'S MAGNETIC POLES

The earth, far from being magnetized in the simple manner above supposed, is instead most irregularly magnetized, the distribution of land and water evidently playing an important rôle. In place of the magnetic poles being on opposite sides of the earth, the North Magnetic Pole is in about latitude 70° north and longitude 97° west, and the South Magnetic Pole is approximately in latitude 73° south and 156° east. Draw a straight line connecting the two poles and it will pass through the earth 750 miles off from the center. No formula has as yet been found which, even if we knew the exact positions of the two magnetic poles, could give the direction of the compass at any point of the earth sufficiently close to satisfy the demands of the navigator and the surveyor.

NATIVE HOUSE: PUNTA GORDA, BRITISH HONDURAS

CATHEDRAL ENTRANCE: HUEHUETENANGO, GUATEMALA

Hence, instead of mathematical tables, charts must be supplied to the mariner showing him, wherever he is likely to go, just how the compass points. But, to construct these charts, some one must have found previously, by actual observation, the relation or angle between the true north and the magnetic or compass north. The mariner knows these charts by the name of "Variation Charts," and the lines drawn on them as, "Lines of Equal Variation," which connect all places where the "variation" or compass direction is the same, just as the isothermal lines on a weather map join the places of the same temperature. The

GRANITE COLUMNS, TEMPLE OF THE SPHINX, GHIZEH, EGYPT

more scientific term is "Lines of Equal Magnetic Declination."

The first one to construct such a chart was the noted Astronomer Royal of England, Edmund Halley, who, at the expense of the English government, sailed over the Atlantic Ocean on the ship *Paramour Pink* between 1698 and 1700, and in 1701 published the first "Lines of Equal Magnetic Variation," chiefly, of course, for the Atlantic Ocean. Since then various expeditions have been sent out and new charts have been issued. Of such expeditions, the most recent and extensive was that of the *Challenger*, 1872–1876, again supported by the English government. In fact, to that government and to its various scientific bodies must be given the credit of having contributed most hitherto, of any nation, to the advancement of our knowledge of the earth's magnetism. One of its most noted scientific men, Prof. J. A. Fleming, thus concludes his excellent address* on "The Earth, a Great Magnet;"

* Published in the Journal "Terrestrial Magnetism and Atmospheric Electricity," vol. II, 1897.

delivered to the workingmen of Liverpool, September 10, 1896, at the time of the meeting of the British Association for the Advancement of Science:

"That great empire which has its center in these islands, but its dominions scattered over distant seas, has been built up primarily on the art of navigation, in which the magnetism of the earth is a central fact. Neither its world-wide commerce, nor the naval power which defends its coasts, could exist for a day without the aid of the magnetic compass."

THE MAGNETIC SURVEY OF THE EARTH

But, if so much splendid work has already been done, why is it necessary for the Carnegie Institution of Washington to do so much? From 1905 to 1908 it had the brigantine, the *Galilee*, on the Pacific Ocean, the aggregate length of whose cruises amounted to 60,000 miles. Now it has a specially constructed vessel engaged in magnetic work on the Atlantic. Its magnetic observers have already penetrated to nearly every part of the earth—Greenland, Baffin Land, Labrador, Newfoundland, British North America, Mexico, Central America, Panama, Colombia, Ecuador, the Guianas and

FOUNTAIN IN THE ALABASTER MOSQUE OF MOHAMMED ALI, CAIRO, EGYPT

DESERT SCENERY: HELWAN, EGYPT

Venezuela, West Indies, Bermuda, Africa, Turkey, Asia Minor, Persia, Asiatic Russia, China, and the South Pacific Islands. It is, furthermore, coöperating with various polar expeditions, and is thus securing magnetic data in those far-off regions. In another five years it is confidently expected that the Carnegie Institution of Washington will be able to issue new sets of magnetic charts for nearly the whole earth, as based for the first time upon uniformly and systematically acquired data.

Why was all this work needed, and why is it that this country has now taken the lead and has the good-will and the effective coöperation of every civilized country in the prosecution and completion of a project covering the entire globe—"the magnetic survey of the earth"?

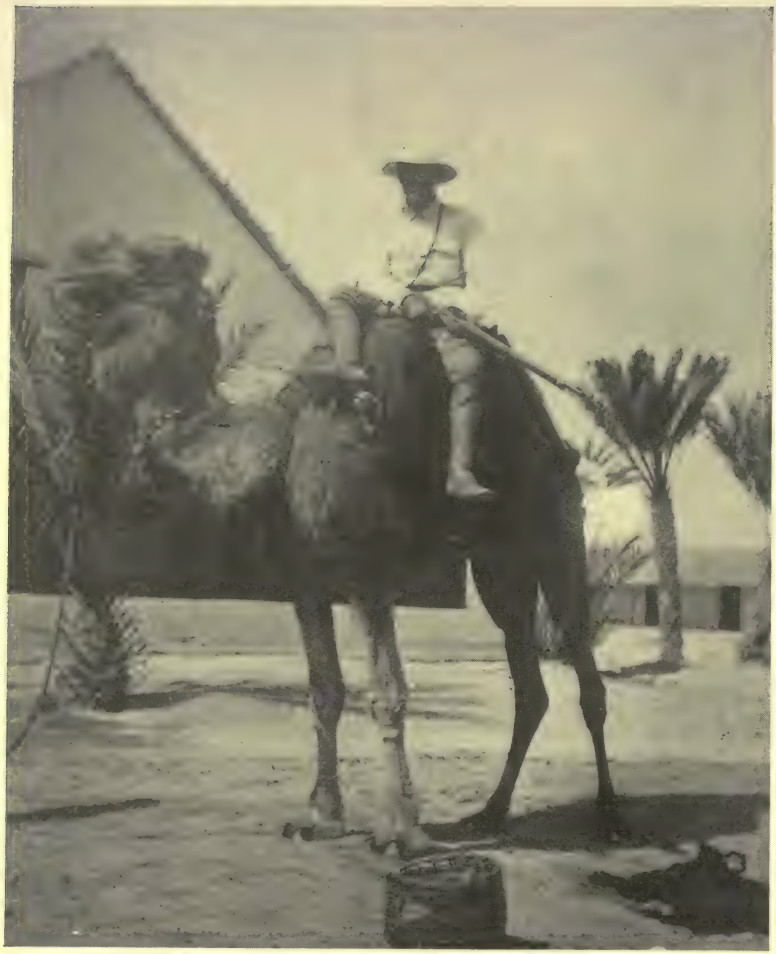
"THE MAGNETIC STATE OF OUR GLOBE IS ONE OF SWIFT AND CEASELESS CHANGE"

In the year 1634 Henry Gellibrand, professor of mathematics at Gresham College, found, upon careful observation, that the compass pointed, at London, 4 degrees 6 minutes east of north. His predecessor had observed, in 1622, not quite 6 degrees, and Borough and Norman, in 1580, had noted 11¼ degrees east. Hence between 1580 and 1634 the easterly direction of the compass had changed by 7 degrees. Before Gellibrand's time it had become generally known that the compass changed its direction from place to place over the earth, but it was supposed "fixed and invariable at any one place"; but now an entirely new fact became known.

Since Gellibrand's time the fact that the compass changes its direction with time has become definitely known, and has painfully impressed itself upon every surveyor who has attempted to relocate land bounds by the bearings recorded in the original deeds of conveyance. He must make due allowance for the changes, and that is just where the trouble comes in—the amount of change to allow since the original survey. For the same reason navigators' compass charts are soon put out of date and so require to be corrected.

Sir John Herschel aptly said:

"The configuration of our globe—the distribution of temperature in its interior — the tides and currents of the ocean—the general course of the winds and the affections of climate—whatever slow changes may be induced in them by those revolutions which geology traces—yet remain for thousands of years appreciably constant. * * * But the magnetic state of our globe is one of swift and ceaseless change. A few years suffice to



TRAVELING IN PERSIA ON CAMEL

alter materially, and the lapse of half a century or a century to obliterate and completely remodel the form and situation of those lines on its surface which geometers have supposed to be drawn in order to give a general and graphical view of the direction and intensity of the magnetic forces at any given epoch."

We thus see the need of repetitions of magnetic surveys.

MAGNETIC STORMS OCCASIONALLY PARALYZE THE TELEGRAPH WIRES AND PREVENT THE TRANSMISSION OF TELEGRAMS

By this time the reader will doubtless have received the impression that the earth's magnetism, at best, is certainly a most unsatisfactory source of guidance, and so it undeniably is. But matters are still worse than already shown. The magnetic needle is subject to all sorts of fluctuations in addition to the one already described. Fortunately most of them are of too short duration or of too small an amount to require attention for the practical purposes of navigation. However, in time of a severe magnetic storm, as occurred on September 25, 1909, the compass may change its direction 5 degrees and more in a quarter of an hour, even at a place so far distant from the North Magnetic Pole as is the city of Washington. But

BEGGAR AT MAHUN, PERSIA

these are more or less temporary derangements, and after a certain time the needle recovers its normal direction. Frequently during the so-called "magnetic storms" there are electric currents generated in the earth of sufficient strength to interfere seriously with telegraphing and cabling.

Were it possible to substitute something else for the magnetic compass it would be a waste of funds, as judged from the "purely practical standpoint," to carry on the extensive magnetic operations of the Carnegie Institution of Washington. However, nothing has been found as yet which "fills the bill" as well as the compass, in spite of its manifest defects.

THE "GYROSCOPE COMPASS"

The papers have recently had considerable to say regarding the so-called "gyroscope compass." This instrument is not dependent for the maintenance of its direction upon the earth's magnetism, but is an embodiment of the principle of the spinning top. The spinning is done by an electric motor, a 9-pound wheel rotating about 21,000 times a minute. Just as the axis of the top maintains an invariable direction while the top is in rapid motion, so does the axis of the gyroscope remain unaltered for some time in the direction originally set; this direction may be due north and south, for example. The precise advantage of this instrument is, that it is unaffected by any neighboring iron, and hence this sort of a compass is peculiarly useful on the modern steel vessels and on war-ships. Instead, however, of displacing our old standby, the magnetic compass, it must be regarded chiefly as an adjunct to the

MAGNETIC SURVEY CARAVAN THROUGH COPPER HILLS, PERSIA

FORT AT BAMPUR, PERSIA

THE "CRESCENT": ADEN, ARABIA

present appliances for controlling and checking a ship's course and her position.

When the solar azimuth attachment was devised, with the aid of which the surveyor was enabled to run true lines instead of magnetic ones, some believed that the compass needle for surveying was doomed. But the sun and stars are not always visible, whereas the earth's magnetism is ever in evidence, and the temptation to resort to the needle could not be resisted. Then again, for running a line through dense forests, or for laying a trial course between two non-intervisible objects, the transit instrument presents difficulties; the line must be cut open, trees must be felled to permit the surveyor to sight ahead and plant his stakes. The compass surveyor, however, may pick his way unaided through the thickly-wooded jungle, and, while his line may not be as true as that of the transit-man, it frequently suffices for the purposes, if traced with some care.

So it is with this recently invented Anschuetz-Kaempfe gyroscope compass now being installed on German war vessels, and said to be used with success by them. Let those use it who can afford to do so, and who, above all, have the time and facilities for studying it and checking its indications thoroughly. It is safe to say that, even on vessels thus equipped, the magnetic compass will not be wholly discarded. In fact, it may turn out that the new instrument will be most serviceable if used as a control or check upon the mariner's compass. For ordinary vessels the expensiveness, cumbersomeness, and frequent necessary control by sun or stellar observations of the new instrument will be prohibitive. It should be stated that if the gyroscope is set whirling with the axis pointed due north at the port of departure, and a due east course is set, for example, the axis will not continue to point due north—this because of the convergency of the meridians. Hence this instrument will also have its errors or deviations, not due this time to the iron in the ship, but simply

A NATIVE TYPE: TRANSCAUCASIA

because the earth is not flat, but round. The ordinary mariner would not find it easy to determine and check up on these errors.

Hence the gyroscope compass, while a most useful and ingenious invention, also has its limitations, and will not at present answer the requirements for continual and universal use. Thus we are again brought face to face with the necessity of making a most careful study of that which the Supreme Architect has given us—the earth's magnetism.

WHY DO THE MAGNETIC POLES MOVE?

I trust the why and wherefore of the magnetic work of the Carnegie Institution of Washington has now been made clear: To make the most complete study possible of the earth's magnetic forces, both as regards their direction and their strength, and, having done this, to determine the changes forever going on, in order that magnetic charts may be kept up to date for the use of the navigator, the surveyor, the explorer, and the man of science.

Thus far only the purely practical and sordid side of a "Magnetic Survey of the Earth" has been presented, but, happily, man will not thus be contented; he wants to know, not simply the "how," but the "why" as well. The many intelligent questions received at the office in Washington and those put to us by persons of all walks of life who visit the *Carnegie*, when in port, must be taken as evidence of genuine interest. I question whether ever before so many people the world over have been led to inquire, What is "terrestrial magnetism," anyway? To be sure, some of the letters are addressed to the "Department of Celestial Magnetism," or to the "Department of Terrestrial Rheumatism," etc. In the main the questions asked are: Where is the Magnetic North Pole? Does it move, or is it fixed? If it moves, is this the reason why the compass changes its direction from year to year? What makes the magnetic poles move? What is the cause of magnetic storms, and what is their connection with auroral lights, electric currents in the earth, and sun spots?

For most of these queries the data are at present either lacking or not sufficient to give definite and complete answers.

THE NON-MAGNETIC YACHT "CARNEGIE"

Now to return to the clipping quoted in our opening paragraph. First of all, let me correct a popular misapprehension: the *Carnegie* is in no wise either owned or controlled by Mr Andrew Carnegie. To him, however, who has acquired his wealth from the successful

manufacture of steel is due the construction of a vessel in which *every effort was made to avoid steel.* The *Carnegie* is owned by the Carnegie Institution of Washington, founded by Mr Carnegie. She was built solely from the funds of the Institution, and has been placed by the trustees directly in the charge of the writer as director and managing owner. The command of the vessel has been intrusted to Mr W. J. Peters.* The vessel is classified as a "yacht" to facilitate port entries as to customs, etc.

CAMEL IN GARI: SHEIKH, ARABIA

PRINCIPAL FACTS REGARDING THE "CARNEGIE"

Dimensions: Length over all, 155½ feet; length on load water-line, 128¾ feet; beam, molded, 33 feet; mean draft, 12 feet 7 inches; displacement, 568 tons; registered tonnage, 246.

Materials used: White oak, yellow pine, Oregon pine, teak.

Fastenings: Locust treenails, copper and Tobin bronze bolts, composition spikes.

Anchors: Four of manganese bronze; total weight, 5,500 pounds.

Anchor chains: None; instead, three 11-inch hemp cables, each 120 fathoms.

Sail power: Brigantine rig, 12,900 square feet of plain sail; rigging, special Russian hemp; all metal-work on spars, rigging, and blocks of bronze and gun-metal.

Auxiliary power: 150 indicated horse-power producer gas engine, built practically of non-magnetic metals, chiefly bronze and copper and non-magnetic manganese steel.

Boats: Two non-magnetic 20-foot whale-boats, one 16-foot gig.

Cooking ranges and refrigerating plant: Bronze and copper.

Cutlery: Mexican silver.

Personnel: Scientific staff — 7 men; crew, 14; 21 in all.

Naval architect: H. J. Gielow, of New York; builder, Tebo Yacht Basin Co., Brooklyn, under the management of Wallace Downey.

First vessel built non-magnetic.

First sea-going vessel equipped with a producer gas engine. In calm weather, a day's run can be made, with auxiliary power alone, of 144 nautical miles, at total cost for coal consumed of $7.

Her object: Sun and stars serve to shape a ship's course only when visible; the earth, however, by its magnetic power, directs the mariner's compass unfailingly, be it night or day, cloudy or foggy. To reap the fullest benefit possible from this natural agency the *Carnegie* is mapping out the magnetic forces as they prevail over the oceans, for the good of all countries. Her mission is hence international.

Thomas Hood, in his amusing poem, "The Compass with Variations," must have anticipated the building of a *Carnegie:*

> "They found no gun—no iron none
> To vary its direction."

Newspaper reporters have accused us of being so fastidious that the applica-

*Mr Peters was the representative of the National Geographic Society on the Second Ziegler Polar Expedition, being second in command and in charge of the scientific work. Upon his return he accepted the command in 1906 of the *Galilee*, then engaged in magnetic work in the Pacific Ocean for the Carnegie Institution of Washington.

BOSTAN, AT THE FOOT OF THE HIMALAYAS

MAGNETIC SURVEY PARTY STARTING FROM HONANPU, CHINA

SAND DUNES NEAR KHOTAN CHINESE TURKESTAN

CARAVAN OF MAGNETIC EXPEDITION ALONG KARAKASH RIVER

THE CARAVAN AMONG THE HIMALAYAS, SEPTEMBER, 1909

THE LEADER OF THE MAGNETIC EXPEDITION CROSSING HIMALAYA MOUNTAINS

tion of a competent sailing master was "turned down" solely because of his "iron" constitution, and that we allowed only "bronzed" sailors on board the *Carnegie!*

But, why was it necessary to build a vessel practically without iron, and just what is the advantage in discovering chart errors with her?

As the reporter correctly says:

"There is only one non-magnetic vessel afloat, and that is the *Carnegie,* and the magnetic vessels seem to have got along very well in spite of errors."

EFFECT OF SHIP'S IRON ON THE COMPASS

The iron on board a vessel affects the compass needle generally in the following two ways: First, it disturbs and alters the normal direction of the needle and hence introduces the error known as the "deviation of the compass"; secondly, it weakens the component of the earth's magnetic force acting on the compass. Both effects require to be considered; they are neither of them constant, but vary from place to place. They depend upon the ship's course and change with every alteration in the ship's own magnetism, due to variable cargo and other causes. Even the continuous impact of waves on an iron vessel has an appreciable tendency to "set" or "unset" the lines of magnetic force in the vessel and thus produce a change in the deviation error.

To overcome the baneful effects of an iron vessel on a compass, the latter is "adjusted"—that is, other pieces of iron and magnets are placed in the vicinity of the compass in such a way as to exert an equal and opposite effect to that of the ship's own iron and magnetism. To make this "adjustment" it is necessary to know first how the compass would point were it mounted on a vessel with no iron whatever in her—*i. e.,* on a non-magnetic vessel like the *Carnegie.* Whether a thing is wrong, and, if so, how much it is wrong, cannot be told until one knows what is correct.

To determine the size and strength of the compensating magnets it does not suffice to know merely the correct compass direction at the port of embarkation; the dip of the magnetic needle and the strength of the earth's magnetic force must also be known. Suppose that after various trials the adjuster has succeeded in "correcting" the compass, so that it points just as it would have done in the first place had there been no iron or steel in the ship. Starting off on a trans-Atlantic voyage, we soon find that our compass has not remained "put," but, instead, again shows "deviations" from the magnetic north, due to some of the many possible causes already mentioned.

What does the mariner do? Whenever the sun or a star is visible he makes an "observation" and finds how his disturbed compass is pointing. Thus, for example, in latitude 43°.8 north, longitude 58°.9 west, the north end of his compass shows 25° west of north. Turning to his charts, he learns that, according to the British Admiralty Chart, the bearing or "westerly variation of the compass" should be 22°.2; according to the U. S. Hydrographic Office, 23°, and by the German Admiralty Chart, 22°.4. Taking the average of the three best charts now in actual use, he finds that, where his ship is, the compass should stand 22½° west, but he actually found 25° west; hence, assuming the charts to be absolutely correct, he concludes that the deviation error of his compass at that place is 2½° west for a particular heading of ship. And, if he is a cautious captain, he will embrace every chance to "check up" when astronomical observations are possible.

IMPORTANT ERRORS ON CURRENT CHARTS CORRECTED BY THE "CARNEGIE"

But we, on the *Carnegie,* having no effect from iron to contend with, found, on September 22, 1909, that in 43°.8 north and 58°.9 west, the compass actually pointed 23°.7 west. If the mariner had known of this correct value he would have found as the deviation error of his compass 1°.3 west instead of 2½° west. I have taken a favorable case; greater differences between the *actual* and the

GLACIER, SASER PASS, HIMALAYA MOUNTAINS

A MAGNETIC OBSERVER TRAVELING ON A YAK: SANJU PASS

apparent deviation errors may readily occur. It is thus seen that, before the navigator can determine successfully the outstanding errors of his compass and make proper allowance for them during the interval of night and cloudiness, when celestial objects are obscured, he must know what is the correct "variation" of the compass—*i. e.,* the direction which would prevail had he no source of disturbance beneath him. *The purpose of the work of the Carnegie is to give the mariner correct information.*

With the appliances on board the *Carnegie* there were disclosed, in the short space of six weeks (September 1 to October 14, 1909), systematic errors of importance in the best charts now available. The existence of these errors had been more or less suspected during the past ten years, but, in spite of many thousands of observations on iron vessels by expert and conscientious men, they could not be definitely laid bare. The *Carnegie's* results are accepted as correct by the leading hydrographic offices of the world. Similar systematic errors of consequence have been disclosed on the cruise from Madeira to Bermuda and New York. The *Carnegie* returned safely to the latter port on February 10 last, having completed a cruise of 8,000 miles since September 1, 1909. She successfully weathered the many severe storms of the early part of this year. Her next cruise will be a circumnavigation one of the globe.

ESKIMO GIRL: KANGERDLOOKSOAH, GREENLAND

ESKIMO WOMAN AND BABY: GREENLAND

SHIPWRECKS MAY BE CAUSED BY COMPASS ERRORS

Those in command of vessels, for one reason or another, frequently entrust the compensation of their compasses to some hired adjuster who, after completion of his work and when the vessel has been swung, furnishes what is called a "deviation card," namely, a table showing the corrections or errors of the compass on the various headings of the ship. I was

METHODS OF CARRYING INSTRUMENTS AND BAGGAGE IN NORTHERN CANADA

shown at St Johns, N. F., last September, a card furnished to a coast liner by a New York compass-adjuster. This card was so manifestly wrong and impossible that, if the captain himself had not suspected its incorrectness and had not made observations at the earliest opportunity when his vessel left port, she would surely have gone ashore.

When some years ago a great liner was wrecked by going on the rocks, there was a great deal said about "local magnetic attraction of the rocks," where, as a matter of fact, practically no attraction existed. It is of interest to know, however, that the same man who had adjusted the compasses on board that liner had previously performed a similar duty on a private yacht whose owner, a scientific man, found just in time that grave errors and "misadjustments" had been made. This may be simply a coincidence, but there is no question that a captain cannot wholly trust to adjustments made for him, and that he must have the means of checking up as often as possible. For that purpose he must know, in the first place, just what the correct or undisturbed "variation" or direction of the compass is in all the waters he is likely to traverse.

LOCAL ATTRACTIONS OF THE COMPASS

One further source of danger to navigation must be cited. A number of regions have been found which attract the compass, due frequently to large local deposits of magnetic iron ore. These regions thus have the same effect as the iron on board ship, with this difference, however, that, in general, they exert a constant effect, which, when once determined, can thereafter be allowed for. For example, the Madeiras, the Bermudas, and, in general, islands of volcanic origin are places of more or less pronounced local attraction. Along the inner passage from Seattle to Alaska, there are several places where the attraction from the shore is so strong as

MAGNETIC OBSERVER AT WORK IN CANADA

MOSQUE AT MAHUN, PERSIA

to seriously affect ship's compasses a mile away. Did the mariner not know of them or not allow for their effect while passing them during the night or in fog, his vessel would surely go ashore.

It is a part of the work of a "magnetic survey of the earth" to locate the areas of local magnetic attraction and to make known their effect for the guidance of the mariner.

THE DUKE OF THE ABRUZZI IN THE HIMALAYAS

IN recent addresses to the Alpine Club at Turin, and to the Royal Geographical Society of Rome, the Duke of the Abruzzi spoke on his Himalayan explorations of 1909. May and June were passed in unsuccessful efforts to ascend the huge pyramidical mountain known as K^2. From the base camp at Rdokass, near the center of the Baltero glacier, an advance bivouac was made at the foot of the southern wall of K^2. Unavailing efforts were made to locate practicable trails on the east and west sides, but everywhere were either very steep ridges of loose, broken rock or sheer precipices and impassable glaciers.

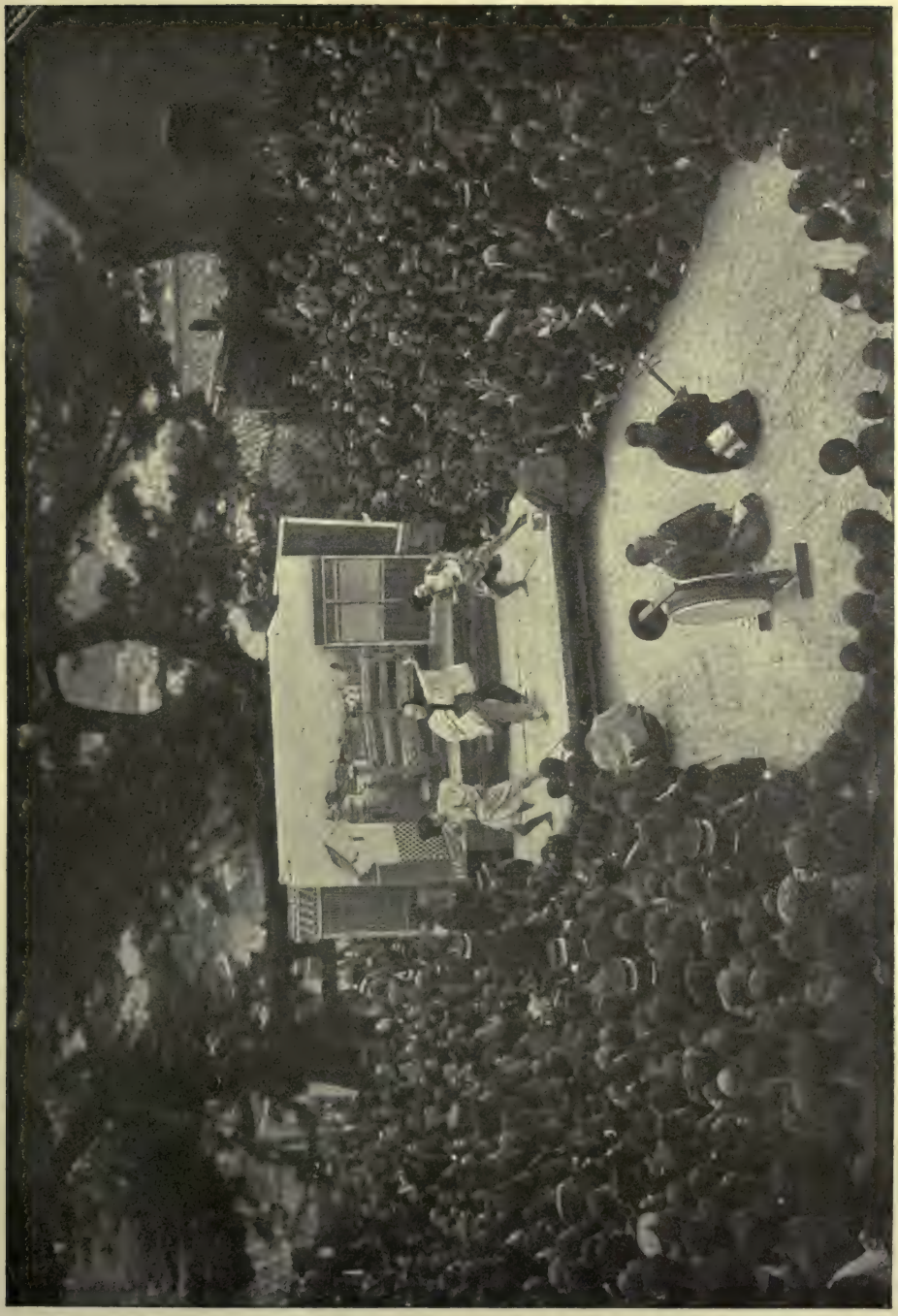
However, the Duke attempted an ascent up the east-southeast ridge, where the conditions were so difficult and dangerous as to cause him to turn back at an altitude of about 16,000 feet. A second unsuccessful attempt was made on the west flank. The upper basin of the Austen-Goodwin glacier was surveyed, and the Duke was enabled to get views of the north side of K^2 and of the hitherto unknown district to the east.

In July efforts were made to ascend Brides Peak, on whose flank a base camp was established on the Chogolisa saddle.

The Duke passed three weeks at an altitude exceeding 21,000 feet, and made two attempts under conditions of great discomfort and considerable danger, owing to the monsoon weather, which brought heavy snow and dense clouds. Reaching 24,000 feet in one attempt, he

DANCING AT A SHINTO RELIGIOUS FESTIVAL: JAPAN

Photo from Rev. H. B. Johnson



JAPANESE THEATER AT RELIGIOUS FESTIVAL

Photo from Rev. H. B. Johnson

Photo from J. R. Joy

A JAPANESE FIRE BRIGADE DRILLING

attained on his second definite climb, on July 18, with two guides, the record height on Brides Peak of 24,583 feet. The ridges were dangerous and difficult, while further progress was barred by a dense fog which enveloped the party about 500 feet below the summit, which is 25,119 feet.

This unsurpassed height of 24,583 feet supplants the previous world record of 24,000 feet on Mount Kabru, attained by Norwegian mountaineers in 1908.

The Duke supplemented his strictly mountaineering feats by extended surveys, hypsometrical observations, meteorological records, and other scientific data of value and interest. His work is entitled to the highest possible recognition from geographers of all nations.

A. W. G.

IN VALAIS

By Louise Murray

Illustrations from Photographs by Jullien Frères, Geneva

APROPOS of all the present talk about woman suffrage, let us take a glance at the inhabitants of a small village in Switzerland, or, more accurately, the dwellers on the mountain slopes about Champéry, in the canton of Valais, that sequestered and charming hamlet which lies contentedly at the feet of its famous neighbor, the Dent du Midi.

There the sturdy peasant women have solved the "equal-rights" matter to their own satisfaction. Votes were never a factor in the question, but trousers were, and have been calmly appropriated for their own use; so it is as man's equal in freedom of movement and attire, at least, that the feminine half of the community tend their herds, cut hay on the almost perpendicular hillsides, and clamber up and down the stony and tortuous paths leading to their mountain homes.

If Americans are as yet in almost total ignorance of this little spot, successfully hidden for years at the extreme end of the lovely Val d'Illiez, it is by no means undiscovered, and, owing to the recent foreign invasion, these fair traitors to the conventional skirt have become as shy as the proverbial chamois, and one must seek them upon their own heights during the summer season, when the new electric tramway which has supplanted the old-time diligence renders this village almost too accessible to the ever-growing tourist army.

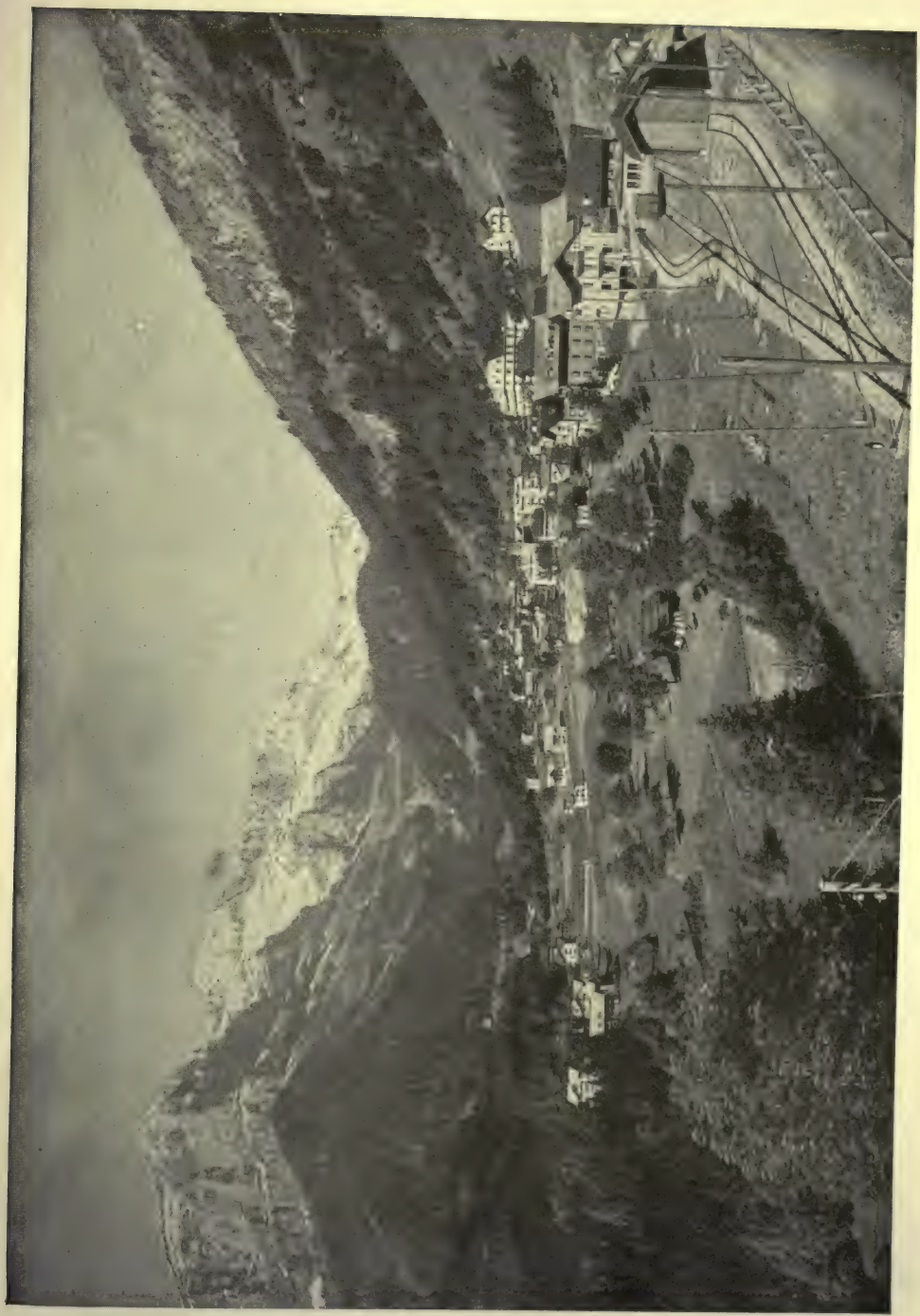
En route from Italy, one leaves the Simplon line at Saint Maurice, rides for a few minutes in a shuttle train of doubtful comfort, and, arriving at Monthey, takes the tram, which immediately commences an ascent of the fertile valley. Through vineyard and chestnut grove, over roaring mountain streams and past various hamlets, the little train wends its way, ever upward.

Leaving the heat of the plain below, one gradually emerges into an atmosphere of crystalline coolness. Champéry, the end of the railway and the last village in the valley, lies 3,500 feet above the sea. Except its bracing air, one is unconscious of the altitude, as all about tower the infinitely greater heights of the Dents du Midi and the Dents Blanches, their white "teeth" so dazzling in the sunlight that one welcomes the almost ever-present curtain of cloud which veils their brightness. Some 300 feet below the village the rapid and noisy Vièze, home of that delectable fish, the "ombre," rushes down the bed of the valley from its source in the Col de Coux, another mountain, at whose summit lies the frontier of Savoy and a customs-house, and from whence one may

FEMININE COSTUMES OF CHAMPÉRY

ON A COUNTRY ROAD NEAR CHAMPÉRY

THE DENTS DU MIDI



CHAMPÉRY AND THE "DENTS BLANCHES"

THE VILLAGE STREET: CHAMPÉRY

"LE CALVAIRE"

continue one's walk in France to Chamonix.

The country abounds in walks and climbs to suit the most expert or inexperienced mountaineer. First and foremost of these is the ascent of the Dent du Midi, more than 10,000 feet in height. Of its seven teeth, the Haute Cime is most popular and least dangerous. Parties usually leave Champéry in the afternoon, sup at Bonaveau, snatch a few hours of sleep, and are off before dawn in order to reach the summit for a far-reaching panorama of the sun-kissed Alps awaking from their sleep.

It was at this little chalet of Bonaveau that one party, finding their hopes of an ascent shattered by torrential rain, resolved to play bridge and amuse themselves as best they could until the wee sma' hours; but "English as she is spoke" and accompanying laughter evidently jarred upon the proprietor's nerves, for in the morning their modest bill was embellished with the strange item, "Extra: Pour bruit fait pendant la nuit (for noise made during the night), 5 francs."

To return to the village, its one street lined by chalets with gayly flowering window-boxes and neat gardens, hotels, pensions, and little shops, let us occupy ourselves with the cosmopolitan throng that wanders back and forth on any August day.

The Hotel Dent du Midi, Champéry's largest and most modern hostelry, is the best point of vantage for such a survey. Choosing a comfortable chair from beneath its striped awnings, we call a waitress wearing one of the typical scarlet kerchiefs on her head to bring us tea. While waiting we may listen to the orchestra and marvel at the many countries of the world represented in this small corner of it. The English and French element predominate, and as yet the American is in the minority, but electricity, steam heat, and all the commodities of modern life that especially recommend a place to his luxury-loving heart are fast doing away with its former simplicity. What a field in which to study human nature, national characteristics, and that intangible something which stamps indelibly the types of each country for its own.

There goes a former prime minister of Austria off for a walk with his beautiful wife, his fox terriers bounding in glee at his heels. A distinguished Roman and his two sons are returning from an all-day climb, their arms filled with Alpine roses. Here comes an English army officer, pack on back and alpenstock in hand, off with his guide for "the Dent." A little Indian princess tosses a bit of cake to her squirming and anticipatory dachshund. Out in the garden four hilarious Parisiennes are settling their accounts at bridge. A Greek countess flicks the ashes from her cigarette, as she sips her tea in company with a young Roumanian. An Italian admiral strolls into the "poste," and the inevitable American girl returns from tennis. So one might continue indefinitely, for Swiss, Dutch, Russian, Hungarian, and even Egyptian are all represented in this out-of-the-way little place to such an extent that during the annual tennis tournament lodging of any sort, be it ever so homely or primitive, is at a premium.

It is in June, however, that Champéry is at its loveliest. Then the fields are carpeted with masses of wild flowers of the most extraordinary beauty and variety, delicate orchid-like blossoms that might have been hot-house grown mixing with the more sturdy ones, and it is with real regret that one sees them swept away by the relentless scythe in haying time. In the heart of the village lies the newly restored parish church, with its unique and ancient crown-capped bell-tower, from which a veritable chaos of chimes peal forth on feast days.

Mention of Champéry would not be complete without a word as to its favorite strolls, the "Petit" and "Grand Paradis"—two lovely wooded spots by the rapid Vièze, where one may sit beneath the pines and listen to its noisy music—and "les Galeries," a natural rock formation in the sheer cliff rising from the right bank of the river, and from which a splendid view of the village is to be had.

But it is toward the east, a half hour distant, that we wend our way most frequently, for there lies "Le Calvaire," a stone cross set upon a projecting knoll which dominates the entire Val d'Illiez far down to the peaceful Valley of the Rhone and across to the distant peaks of Chaussy, Gummfluh, and the Mont d'Or glistening in the sun. From this point, midw between the valley and the mountains, seated beneath that cross, eternal symbol of death, one may best watch the mystery of the departing sun as it sinks behind the Col de Coux. Then the veil that hangs all day before the Dent du Midi lifts, and the dying rays slowly flood the mountains' cold, dead whiteness with the rosy glow of life and eternal promise.

Photos from Paul Thompson

A CAR EN ROUTE UP THE WETTERHORN: GRUNEWALD VALLEY, UPPER BERNOIS, SWITZERLAND

A FUNERAL IN THE ALPS IN WINTER

Photo from Paul Thompson

TWO CARS ON THEIR WAY—ONE IS GOING UP AND THE OTHER DOWN: THE WETTERHORN RAILWAY. EACH CAR HOLDS 20 PASSENGERS

Photo from Paul Thompson

A CAR ARRIVING AT THE UPPER STATION OF THE WETTERHORN: SWITZERLAND

Photo from Paul Thompson

IN THE FRENCH ITALIAN ALPS: USING DOGS FOR CONVEYING GOODS AND PEOPLE DURING THE WINTER MONTHS

Photo from Paul Thompson

TRAVELERS AT THE HOTEL ON MOUNT FLUELA, IN THE ALPS, IN WINTER

Photo from Paul Thompson

HIGH VALLEY OF DOERFLI-LERTIG BETWEEN THE VALLEY OF DAVOS AND ENGADINE

A SEA OF CLOUDS—A RARE SIGHT: TAKEN IN THE ITALIAN ALPS

Photo from Paul Thompson

TOP OF MALOJA, UPPER ENGADINE, SWITZERLAND Photo from Paul Thompson

The valley of the Upper Engadine is famous as a health resort, the most popular place being Saint Moritz

THE PASS OF SAINT GOTHARD IN WINTER Photo from Paul Thompson

The road over this pass, constructed 85 years ago, is one of the best in the Alps, and is free of snow for four or five months. It is remarkable for the grandeur of its scenery, but has not been much used since the building of the railway and Saint Gothard tunnel.

Photo from Paul Thompson

A VILLAGE IN THE ALPS

TRAIN GOING UP THE JUNGFRAU

Photo from Paul Thompson

Photo from Paul Thompson

THE STATION RESTAURANT, 2,338 METERS IN HEIGHT, ON THE WETTERHORN: THE GLACIER OF GRUNEWALD IN THE DISTANCE

DEER FARMING IN THE UNITED STATES *

That the rising prices of beef and mutton in the United States can be partially overcome by raising deer for venison, is maintained by Dr C. Hart Merriam, Chief of the United States Biological Survey. According to Doctor Merriam elk meat can be produced cheaper than beef or mutton in many sections of the United States, and, with comparatively little effort, it is possible to make raising deer for venison as profitable as any other live-stock industry. Every one who has seen the large numbers of deer browsing on private estates in England as peacefully as cattle and sheep wonders why American enterprise has not long since developed breeding deer for food in this country.

SEVERAL species of deer are suited for breeding in inclosures in the United States; the axis deer, the Japanese and Pekin sikas, the red and the fallow deer of Europe, and especially the Rocky Mountain elk, or wapiti, and the Virginia deer. While experiments with the foreign species named offer every promise of success to the owners of American preserves, the elk and Virginia deer are recommended as best adapted for the production of venison in the United States.

The flavor of venison is distinctive, though it suggests mutton rather than beef. In chemical composition it is very similar to beef. A lean venison roast before cooking has been found to contain on an average 75 per cent of water, 20 per cent of protein or nitrogenous material, and 2 per cent of fat; a lean beef rump, some 65 to 70 per cent of water, 20 to 23 per cent of protein, and 5 to 14 per cent of fat; and a lean leg of mutton, 67 per cent of water, 19 per cent of protein, and 13 per cent of fat.

The general popularity of venison is so great and the demand for it so widespread that overproduction is improbable. The other products of the deer—skins and horns—are of considerable importance, and in countries where deer are abundant, and especially where large herds are kept in semi-domestication, the commerce in both is very extensive.

THE ROCKY MOUNTAIN ELK, OR WAPITI

The wapiti, known generally in America as the elk, is, next to the moose, the largest of our deer. It was once abundant over the greater part of the United States, whence its range extended northward to about latitude 60° in the Peace River region of the interior of Canada. In the United States the limits of its range eastward were the Adirondacks, western New Jersey, and eastern Pennsylvania; southward it reached the southern Alleghenies, northern Texas, southern New Mexico, and Arizona; and westward the Pacific Ocean.

At the present time the elk are found only in a few scattered localities outside of the Yellowstone National Park and the mountainous country surrounding it, where large herds remain. Smaller herds still occur in Colorado, western Montana, Idaho, eastern Oregon, Manitoba, Alberta, British Columbia, and the coast mountains of Washington, Oregon, and northwestern California. A band of the small California Valley elk still inhabits the southern part of the San Joaquin Valley.

The herds that summer in the Yellowstone National Park and in winter spread southward and eastward in Wyoming are said to number about 30,000 head, and constitute the only large bands of this noble game animal that are left. Although protected in their summer ranges and partially safeguarded from destruction in winter by the State of Wyoming, there is yet great danger that these herds may perish from lack of food in a succession of severe winters. Partial provision for winter forage has been made within the National Park, but the supply is inadequate for the large num-

* Abstracted from Farmers' Bulletin 330. By D. E. Lantz, U. S. Biological Survey

bers of animals. Further safeguards are needed to place the Wyoming elk herds beyond the reach of winter starvation.

In addition to the wild herds, there are a considerable number of elk in private game preserves and parks, as well as in nearly all the public zoological parks and gardens of this country. The herds in captivity form the nucleus from which, under wise management, some of the former ranges of this animal may be restocked and from which a profitable business of growing elk venison for market may be developed. At the present time this species affords a most promising field for ventures in breeding for profit.

HABITS OF ELK

The elk is both a browsing and a grazing animal. While it eats grasses freely and has been known to subsist entirely upon pasture, it seems to prefer a mixture of grass and browse.

The elk is extremely polygamous. The adult bulls shed their antlers annually in March or April, and new ones attain their full size in about ninety days. The "velvet" adheres until about August. While the horns are growing the bulls usually lead solitary lives; but early in September, when the horns are fully matured, the mating season begins. Fights for supremacy then take place, and the victor takes charge of as many cows as he can round up and control.

Although the elk is less prolific than the common deer and some other species that have been bred in parks, it increases fully as rapidly as the common red deer of Europe. Moreover, it makes up for any lack of fecundity by its superior hardiness and ease of management. It has been acclimatized in many parts of the world, and shows the same vigor and hardiness wherever it has been transplanted. In Europe it has been successfully crossed with the Altai wapiti and the red deer, and in both instances the offspring were superior in size and general stamina to the native stock.

The flesh of the elk, although somewhat coarse, is superior in flavor to most venison. That of the bulls is in its best condition about the time the velvet is shed. In October their flesh is in the poorest condition. As the open season for elk is usually in October and November, and only bulls are killed, it follows that hunters often obtain the venison when it is poorest. The meat is not best when freshly killed, but should be left hanging for four or five days before it is used.

ELK FARMS

With few exceptions the early attempts to domesticate elk were made by men who were wealthy enough to disregard all thought of profit in raising them. They were usually placed under the care of servants, and the bucks were left uncastrated until they became old and unmanageable. Soon the serious problem of controlling them outweighed the novelty of their possession, and one by one the attempts at domestication were abandoned.

A desire to preserve this important game animal has caused a renewal of attempts to breed it in confinement, and at present there are small herds under private ownership in many places in the United States. The Biological Survey has recently obtained much information from owners of herds in regard to their experience in breeding and rearing the animals, and also their opinions as to the possibility of making the business of raising them profitable. Of about a dozen successful breeders, nearly all are of the opinion that raising elk for market can be made remunerative if present laws as to the sale of the meat are modified.

One especially important fact has been developed by the reports from breeders. It is that the elk readily adapts itself to almost any environment. Even within the narrow confines of the paddocks of the ordinary zoological park the animal does well and increases so that periodically the herds have to be reduced by sales.

The fullest reports that have been received by the Department of Agriculture from breeders of elk are from George W. Russ, of Eureka Springs, Ark.

Mr Russ has a herd of 34 elk. They have ample range in the Ozarks on rough land covered with hardwood forest and abundant underbrush. The animals improve the forest by clearing out part of the thicket. They feed on buds and leaves to a height of 8 feet, and any growth under this is liable to be eliminated if the range is restricted. If not closely confined, elk do not eat the bark from trees, nor do they eat evergreens. In clearing out underbrush from thickets they are more useful than goats, since they browse higher. Goats, however, eat closer to the ground; and as the two animals get along well together, Mr Russ recommends the use of both for clearing up brushy land and fitting it for tame grasses.

The increase of elk under domestication is equal to that of cattle. Fully 90 per cent of the females produce healthy young. An adult male elk weighs from 700 to 1,000 pounds; a female, from 600 to 800 pounds. The percentage of dressed meat is greater than with cattle, but, owing to hostile game laws, experience in marketing it is very limited. An offer of 40 cents a pound for dressed meat was received from Saint Louis, but the law would not permit its export. Mr Russ says:

ROCKY MOUNTAIN ELK: AN ANIMAL WHICH CAN BE PROFITABLY RAISED IN ALMOST ALL PARTS OF THE UNITED STATES

> From the fact that as high as $1.50 per pound has been paid for this meat in New York City and Canada, and that the best hotels and restaurants pronounce it the finest of all the meats of mammals, we are of the opinion that if laws were such that domesticated elk meat could be furnished it would be many years before the supply would make the price reasonable compared with other meats. Elk meat can be produced in many sections of this country at less cost per pound than beef, mutton, or pork.

Mr Russ thinks that large areas of rough lands in the United States not now utilized, especially in localities like the Ozarks and the Alleghenies, could be economically used to produce venison for sale, and he regards the elk as especially suited for this purpose.

Another feature of Mr Russ's report is of more than passing interest. He says:

> We find from long experience that cattle, sheep, and goats can be grazed in the same lots with elk, providing, however, that the lots or inclosures are not small; the larger the area the better. We know of no more appropriate place to call attention to the great benefit of a few elk in the same pasture with sheep and goats. An elk is the natural enemy of dogs and wolves. We suffered great losses to our flocks until we

learned this fact; since then we have had no loss from that cause. A few elk in a thousand-acre pasture will absolutely protect the flocks therein. Our own dogs are so well aware of the danger in our elk park that they can not be induced to enter it.

Elk thrive best in preserves having a variety of food plants—grasses, bushes, and trees. Rough lands, well watered with clear streams and having some forested area, are well adapted to their needs. About as many elk can be kept on such a range as cattle on an equal area of fair pasture. There should be thickets enough to furnish winter browse, but this should be supplemented by a supply of winter forage.

Except when deep snows cover the ground, elk will keep in good condition on ordinary pasture and browse; but a system of management that provides other food regularly will be found more satisfactory. Hay and corn fodder are excellent winter forage; but alfalfa hay has proved to be the best dry food for both elk and deer. A little oats or corn—whole or chopped—may be fed each day. Elk are fond of corn, and feeding it affords excellent opportunities for winning their confidence and taming them. The same may be said of salt, which should be furnished liberally to all deer kept in inclosures. Running water, although not essential, is of great importance in maintaining elk in good condition.

Elk are much less nervous than ordinary deer, and less disposed to jump fences. When they escape from an inclosure they usually return of their own accord. If tame, they may be driven like cattle. Ordinarily, a 5-foot fence of any kind will confine elk. Henry Binning, of Cora, Wyo., writes us that a 4-foot woven-wire fence is ample for these animals. A small inclosure in which a vicious bull elk is to be kept should be higher and of stronger material.

The cost of stocking an elk preserve is not great. Usually surplus stock from zoological parks or small private preserves may be obtained at low cost, varying with the immediate demand for the animals. At times they have sold for less than $20 a head, and, with the present restrictions on sale, low prices are likely to continue. A few years ago T. J. Wilson, of Lewisburg, Ohio, paid $165 for three animals. A Michigan breeder recently offered to deliver a dozen head, sex and age not given, all fine specimens, for $500. This is, of course, a low price, not more than cattle would bring and less than the venison would be worth if it could be sold. If restrictions on the sale and shipment of venison from private preserves were removed, prices of the stock would, of course, soon advance, and necessitate a greater outlay in starting the business.

BREEDING THE VIRGINIA DEER

The Virginia, or whitetail, deer is the common deer of the United States. Including the half dozen geographic races that occur within our borders, it is distributed over most of the country, except Nevada and the major portions of Utah, Arizona, Washington, Oregon, and California. It is extinct in Delaware and practically so in a number of States in the Middle West. South of our borders a number of closely related species occur.

In view of the wide natural range of the Virginia deer, its adaptability to nearly all sections of the United States can not be doubted. Testimony as to its hardiness in parks and preserves is not so unanimous as that concerning the elk; but the general experience of breeders is that with suitable range, plenty of good water, and reasonable care in winter, raising this deer for stocking preserves or for venison may be made as profitable as any other live-stock industry. Not only do deer thrive on land unsuited for cattle or horses, but, like elk, they may be raised to great advantage in brushy or timbered pastures fully stocked with cattle or horses, as the food of deer rarely includes grass.

Advocates of the Angora goat industry state that within the United States there are 250,000,000 acres of land not suited to tillage or to the pasture of horses, cattle, or sheep, which are well

adapted to goats. Much of this land is suited also to deer and elk, and can be utilized for these animals with less injury to the forest cover than would result from its browsing by goats.

Virginia deer have often been bred in parks for pleasure or in large preserves for sport, but the economic possibilities in raising them have received little attention. Recently breeders have recognized the fact that they are profitable under proper management and would be much more so were conditions for marketing live animals and venison more favorable.

The Biological Survey has reports of successful experience in raising Virginia deer from more than a dozen persons, located in different parts of the country, who are now engaged in the business. The management of the herds varies slightly with the surroundings and the object for which they are kept.

Thomas Blagden, of Washington, D. C., began raising deer in 1874. After an experience of over a third of a century he is confident that the business can be made profitable. In his own herds he has carefully avoided in-breeding by securing new bucks from time to time. His stock is vigorous and of the large size characteristic of the Adirondack and other northern deer. Consequently the animals are in demand for breeding purposes, the bucks bringing $50 each and the does $75. He feeds grain, using corn and a mixture of bran and meal, and during the summer cuts as much wild forage as possible. He finds that the animals prefer the rankest weeds to the choicest grass. Of the various kinds of hay, they prefer alfalfa. He provides abundant water at all times.

John W. Griggs, of Goodell, Iowa, writes that he has been engaged in raising deer for about fourteen years. Until two years ago he sold all his surplus stock for parks, but since then has disposed of about half of it for venison. For park purposes he gets $20 to $30 a head, but they bring fully as much or more when fattened for venison. As to management of deer, Mr Griggs writes:

> In raising a large herd the park should be divided into two or three lots, and one plowed each year and sown to red clover, mustard, rape, and seeds of different kinds of weeds. Bluegrass and timothy are useless. Corn is the principal grain I feed. I feed it winter and summer. In winter I feed also clover hay, oat straw, and weedy wild hay. Deer when rightly handled are very prolific, and from 50 does one can count on 75 fawns. They can be raised profitably for venison—very profitably until overdone; but I would not advise one to go into it on a large scale without previous experience with deer.

The report received from C. H. Roseberry, of Stella, Mo., although less enthusiastic than others, is quoted because his herd approaches more nearly a state of true domestication. Under the date of January 13, 1908, Mr Roseberry wrote as follows:

> My experience in breeding the common or Virginia deer covers a period of seventeen years, beginning in March, 1891, when, as a boy of 16, I built a small inclosure of 1½ acres to confine a single doe that was captured as a fawn in the neighboring forest.
>
> A buck and other does were secured from year to year, until in 1900, by purchase and natural increase, my herd numbered 25 head of all ages.
>
> From 1891 to 1901 I lost every year from disease an average of 20 per cent. The climax came in the drought year of 1901, when my loss was 50 per cent from the disease known as "black tongue."
>
> I am convinced that, like cholera in swine, individuals recovering from this disease are immune from further attack. Apparently all of my herd were afflicted. The survivors and their progeny constitute my present breeding stock. I have made no purchases since 1901, nor have I suffered any loss from disease.
>
> For the last seven years my herd has averaged 70 per cent increase, all of which I have sold at satisfactory prices. I began selling at $20 per pair of fawns at 4 months of age, and $30 per pair of adults. I now get $40 and $60, respectively. I sell almost exclusively for pets and for propagating purposes, although a few surplus bucks have been sold for venison, averaging me 15 cents per pound gross weight.
>
> If we except the goat, I know of no domestic animal common to the farm that requires so little feed and attention as the deer. My herd has a range of only 15 acres, two-thirds of which are set to white clover, bluegrass, and orchard grass. I provide also a small plat of wheat or rye for winter pasture. With the above provision, in this latitude, no feed is required between April 15 and November 15. During the rest of the year a ration of corn, bran, or other mill feed somewhat smaller than that required for sheep, in connection with a stack of clover or pea hay to which they have

HERD OF DOMESTICATED VIRGINIA DEER BELONGING TO R. H. HARRIS, CLARKESVILLE, TEXAS

free access, is sufficient to keep them in good condition. Deer eat with relish nearly all of the common coarse weeds, and for clearing land of brush they are, I think, second only to the common goat.

Probably the greatest expense connected with the business of raising deer is the fencing. Another item of trouble and expense, when the animals are raised for pets, requiring that they be handled and shipped alive, is the fact that the fawns must be taken from the does when 10 days old and raised by hand on cow's milk. They are quite easily raised in this way, with but slight percentage of loss, but require frequent and careful attention for the first month. When they are allowed to run with the does their natural wildness cannot be overcome, no matter how gentle the does may be.

I have found the business profitable on the lines indicated. I believe they could be profitably bred for venison alone—certainly with less trouble and expense, since the fawns would be reared by the does and the trouble and expense of raising by hand would be eliminated.

My experience does not coincide with that of some other breeders in respect to the weakening of reproductive powers of deer by the confinement in parks. I have no barren does. Usually they produce a single fawn at two years of age; afterwards twins, and in rare cases triplets.

While deer are chiefly browsing animals, in captivity they eat nearly every kind of vegetation, including most kinds of garden stuff. They are fond of acorns, beechnuts, chestnuts, and other mast. Lily pads, leaves, lichens, and mosses are freely eaten. With plenty of range and an abundant variety of plants there need be, therefore, no apprehension concerning the deer's food. A good supply of running water must be provided, and the animals should have access to rock salt. If the browse and pasturage are scant, a small ration of grain should be fed. Of the grains, corn is generally recommended as a food; there is no waste, as the deer pick up every grain. Coarse hay full of weeds is preferable to timothy or other tame hays, except alfalfa. Of clover hay, deer usually eat the blossom heads

greedily, but waste the other parts. In winter feeding is necessary everywhere, and in the northern half of the United States shelter of some kind should be provided.

WILD DEER IN PRIVATE GAME PRESERVES

Individual owners, as well as associations, have established large private preserves in many parts of the country and stocked them with deer and other big game. The objects have been to preserve the animals and to provide sport for the owners. In the free life under the protected conditions generally provided, deer do remarkably well, the increase being even more rapid than in small parks.

Deer in Buckwood Park, a New Jersey preserve of 4,000 acres, belonging to Charles S. Worthington, increased in the ten years between 1892 and 1903 from 19 to about 400 head, and the number was then lessened because it was thought too large for the permanent sustaining capacity of the park. The St. Louis Park and Agricultural Company have about 1,000 deer and 400 elk in their 5,000-acre preserve in Taney County, Mo. The Otzinachson Rod and Gun Club six years ago placed about 90 deer, mostly does, in their 4,000-acre park in Clinton County, Pa. These have multiplied to nearly 3,000 head.

The good effect of such preserves on the supply of game in the State should not be overlooked. While they may temporarily restrict the hunting privileges of a few citizens, they ultimately become a source of game supply secondary in importance only to State preserves or game refuges. Already a number of private reserves have become overstocked, and game has escaped or been turned over to the State to become the property of the people. The success of private enterprise in propagating large game in inclosures has thus become an object lesson for State game commissioners and others, and suggests the feasibility of the State's undertaking a similar work for the people.

GAME LAWS RESTRICT DEER FARMING

The chief obstacle to profitable propagation of deer in the United States is the restrictive character of State laws governing the killing, sale, and transportation of game. Many of the States, following precedent, lay down the broad rule that all the game animals in the State, whether resident or migratory, are the property of the State. A few States except game animals that are "under private ownership legally acquired." A few others encourage private ownership by providing a way in which wild animals—deer and the like—may be captured for domestication. Generally, when private ownership of game is recognized by law, the right to kill such game is granted, but the owner is hampered by the same regulations as to season, sale, and shipment that apply to wild game. One by one, however, State legislatures are coming to recognize the interests of game propagators, and game laws are gradually being modified in accordance with the change of view.

The chief source from which deer and elk may be obtained for stocking preserves is from animals already in captivity. These must be transported from place to place or there can be no commerce in them, yet the laws of many States absolutely forbid their shipment. The laws as to possession and transportation of deer carcasses make the shipping of venison also illegal. General export of venison is legal from only six of the States, and three of these have no wild deer left to protect.

The laws concerning the season for killing and the sale of deer are often equally embarrassing to those who would produce venison for profit. The owner of domesticated deer cannot legally kill his animals except in open season. Owners of private preserves are similarly restricted and are limited to the killing of one or two animals in a season. More than half the States and Territories absolutely forbid the sale of venison. A few forbid the sale of venison produced within the State, but permit the sale of

that imported from other States—a most unjust discrimination against home industry.

Instead of hampering breeders by restrictions, as at present, State laws should be so modified as to encourage the raising of deer, elk, and other animals as a source of profit to the individual and to the State.

Safeguards against the destruction and sale of wild deer in place of domesticated deer are not difficult to enforce. For this purpose a system of licensing private parks, and of tagging deer or carcasses sold or shipped, so that they may be easily identified, is recommended.

It is believed that with favorable legislation much otherwise waste land in the United States may be utilized for the production of venison so as to yield profitable returns, and also that this excellent and nutritious meat, instead of being denied to 99 per cent of the population of the country, may become as common and as cheap in our markets as mutton.

NATIONAL GEOGRAPHIC SOCIETY

HON. J. HAMPTON MOORE, Member of Congress from Philadelphia, and for some years a life member of the National Geographic Society, is sending to each member of the Society a copy of his speech, "Peary's Discovery of the North Pole," presented to Congress March 22, 1910. The address, which makes a pamphlet of 36 pages, and is an historical summary of the organization and achievements of the last Peary Expedition, contains much valuable information not previously published.

Particularly interesting is the first publication of the original order of President Roosevelt, in July, 1908, directing that Robert E. Peary be detailed to the U. S. Coast and Geodetic Survey, to make tidal observations along the shore of the polar sea.

Twenty-one large volumes of tidal records were obtained by Commander Peary, November, 1908, to June, 1909, and were delivered to the Government in October, 1909. The experts of the Survey who are reducing and discussing the records report that the tides along the northern coast of Grantland and Greenland are quite different from what had been heretofore supposed, and they expect to obtain important new knowledge after these records have been thoroughly examined.

The Hydrographic Office of the Navy Department has already prepared a chart showing the line of soundings made by Peary. The last sounding was made five miles from the pole. The methods and apparatus used for making the soundings are fully described.

Mr Moore's speech was to advocate the passage of a special resolution which he had recently introduced, and which is also published in the pamphlet as an appendix, that the Congress should accept the verdict of the National Geographic Society commission which examined Peary's records and found that he had reached the North Pole.

The decision of the National Geographic Society has been accepted without question by the Royal Geographical Society of London, and the geographical societies of Berlin, Paris, Geneva, Rome, Brussels, Antwerp, Vienna, Dresden, Madrid, Edinburgh, Saint Petersburg, Tokyo, Mexico, Lima (Peru), the geographical societies of Chicago, New York, and Philadelphia, and practically every geographical society in the world.

IMPORTANT NOTICE

Members of the Society desiring the address for the magazine changed are requested to give the Society three weeks' notice.

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THE NATIONAL GEOGRAPHIC MAGAZINE

LANDSLIDES AND ROCK AVALANCHES

BY GUY ELLIOTT MITCHELL

THE recent disastrous avalanches of snow and earth in the Northwest, while of a different character, recall to mind the tremendous mountain slide which destroyed a portion of the town of Frank, Alberta, a few years ago, and also lend interest to geological investigations covering an extensive area in our own San Juan Mountains of Colorado, which have been subject to monstrous rock and landslides, in some instances the entire faces of large mountains having been demolished.

It is the younger mountain systems, geologically speaking, which are most subject to these rock avalanches. Thus the Himalayas, which represent but infant industries, though lusty ones, in the mountain building line, have a way, like other youngsters of immature character, of tumbling about in a wholesale fashion which would result in great catastrophes were their slopes and valleys populated to any great extent.

Sir William Conway describes the matter of a little shifting of rock which caused the formation of Gohna Lake, in the Central Himalayas, where the spur of a large mountain mass pitched bodily into the valley below. The front of the mountain had been undermined by springs until there was no longer sufficient support, and in the twinkling of an eye a large part of the mountain slid down and shot across the valley, damming its river with a lofty and impervious wall. *Masses of rock were hurled a mile away, blocks of limestone weighing* 30 *to* 50 *tons being sent through the air like huge cannon shots. It is estimated that this slide carried with it* 800,000,000 *tons of rock and debris.*

Plenty of Himalayan landslips quite as extensive as this have been recorded in the last half century, while among the remote and uninhabited regions of the great ranges numbers more are of constant occurrence.

The formations of the San Juan Mountain landslide area point to many such slides as these having occurred. Fortunately this catastrophe era has ended for the mountains of the United States, although it is true that some movement is still in progress, and as in the Alps and in Alberta, man's mining operations may precipitate disasters.

CAUSE OF LANDSLIDES

Aside from the study of landslides with reference to the safety of human life, there is economic value in their investigation as bearing upon man's search for the precious metals. The geologist

LANDSLIDE SURFACE OF ONE OF THE SUMMITS OF RED MOUNTAIN
The entire area is covered with the landslide débris (see page 279)

and the mining engineer look for gold or other metalliferous deposits in certain rock strata, and in ordinary mountain formations these strata are fairly regular; at least their positions can be determined. There may be rock faults, but these the keen geologist can trace. However, it is evident that even men who are supposed to see down a thousand feet into the earth's crust must be perplexed when the surface of a mountain slides off, and two or three strata come tumbling down to pile up on the slopes and the valleys to a depth of from ten to several hundred feet. This chaotic condition of the rocks in a landslide area is therefore the despair of the miner and most trying to even the experienced geologist.

The failure to recognize the true significance of the landslide phenomena and to perceive their extent, have led to very great loss of time, labor, and money in prospecting of the Rico Mountains—a portion of the San Juan—says Dr Whitman Cross, of the United States Geological Survey. The reason that much of the areas prospected have not been recognized as landslide in character is due to the fact that the great slides of the San Juan region, such as that described in the Himalayas, occurred long ago, perhaps about the time of the Glacial period, and many of the surface traces have been obliterated to the casual eye.

Landslides are believed to be due generally to moisture, which, under favorable conditions, undermines foundations and causes a breaking away of overlying rocks. In the San Juan area the surface rocks are volcanic and porous. These are underlain by a likewise porous conglomerate which rests upon a sandy shale. There is no drainage, and the rains and snows sinking through the two surface strata soften the shale and render it plastic.

The earlier physical forms of the San Juan Mountains were much bolder than at present. High, narrow ridges must have existed, but the slipping down of billions of tons of their materials has not only lowered the ridges, but filled the ravines, resulting in the present irregular topography of low relief.

Some of the landslide areas of Colorado show that in the earlier days, quite recent geologically, but probably scores of centuries before the coming of man, there must have been terrific times among her mountains. There have been thousands of slides, and some of them of great magnitude. Possibly the great saber-toothed tigers which ranged in the plains below, and the giant sloths upon which they preyed, along with other prehistoric animals, heard the roar of the descending rocks. But if so, man knows it not, for the age of the older disturbances can be but guessed.

One of the greatest of the early convulsions is known as the Silver Mountain Slide. It covers ten square miles, and the amount of rock which crushed down the mountain sides is beyond conjecture. On the northwestern slopes of Red Mountain about six square miles are covered with landslide debris, while many other landslide areas cover from one to five square miles.

GLACIERS OF ROCK

A singular feature of the San Juan region is the presence of rock streams, veritable rivers of stone, which have flowed down the mountain sides. When seen from a distance they resemble glaciers covered with debris. Ernest Howe* describes these rock streams of which Pierson Basin, in the Silverton quadrangle, is typical.

"Nearly the whole floor of this large basin," he says, "is covered by angular rock debris to a depth of 50 to 100 feet. The length of this rock stream is more than three-fourths of a mile, while its average breadth is about one-third of a mile." with an estimated volume of materia of 13,000,000 cubic yards. "In viewing this enormous mass of debris from a distance, one is at once impressed by its very peculiar form, which is like that of a great tongue of some viscous

* Professional Paper No. 67, U. S. Geological Survey.

A REMARKABLE ROCK STREAM: SAN CRISTOBAL QUADRANGLE, COLORADO

The flow was six miles long and dammed a fork of Gunnison River, creating a lake (see page 281)

substance that has slowly flowed down from the cliffs at the back of the cirque and gradually extended to the outer edge of the basin. The singular billowy surface and the curved, often concentric lines near the front or foot of the mass, and which closely resemble those caused by the cooling of lava streams, strongly add to the appearance of slow movement."

Scores of such rock streams can be seen in the San Juan Mountains. An interesting variation is what is termed by Doctor Cross "Slumgullion mud flow," which dammed a fork of the Gunnison River and formed Lake San Cristobal. At the head of a tributary of Slumgullion Gulch, 11,500 feet altitude, certain rocks had been decomposed into a soft, crumbling sand, underlying, however, other rock masses. In time, perhaps during some abnormally wet season, this incoherent decomposed material became so extensively softened as to be unable to bear the load of rock above, and gave way; the overlying rocks broke into fragments, and the whole mass of mud and rock fragments rushed as a flow down the lateral gulch to the main Slumgullion Gulch, and down that to the Lake Fork, six miles from the place of starting. On reaching the Lake Fork, whose course is here at right angles to Slumgullion, the flow turned north and ended about three-fourths of a mile below the mouth of the Slumgullion. The volume was sufficient to dam the main stream and to cause the formation of Lake San Cristobal, which now extends for nearly two miles up the Lake Fork Valley. The end of the flow is at about 8,900 feet altitude, 2,600 feet lower than its starting point. A sparse forest growth on the surface of the flow shows that the flow occurred many years ago. On the upper part of the flow the trees are in many places overturned or tilted at various angles, testifying to recent movement.

RECENT LANDSLIDES IN THE SAN JUAN

While the great landslides of the San Juan region are doubtless a thing of the past, the recent disaster at Frank shows that American mountains are not entirely trustworthy, and in the case of the San Juan there has been an actual though not very tremendous landslip within the present generation. However, had a city been located upon the three square miles of disturbed area, the movement was sufficient to have ruined it as effectually as did earthquake and fire the cities of San Francisco and Messina.

Late in July, 1886, there appeared in the Denver newspapers a report that an earthquake had occurred in the Cimarron Creek Valley. A few days later Dr Whitman Cross, of the U. S. Geological Survey, accompanied by a photographer, visited the area. The scene of the so-called earthquake was a well-timbered basin, and evidences of such disturbances as had been described were everywhere visible. In some parts nearly all the trees were overturned; in others they stood at various angles, presenting a weird picture. In places were bare slopes, presenting a fissured and step-like structure as if from the dropping down of successive sections of the earth. The movement as described by Cross was a downward sliding of the whole surface, unequal in different places. The impression produced was that a sliding or almost a flowing movement had taken place, involving the whole area of some three square miles. The mischievous agent which had produced the result was unquestionably water. Mud streams were here and there found in which tree trunks and rocks were embedded, while columns and mounds of moist earth were pressed up through cracks by movements of some part of the mass. This appears to have been more in the nature of a surface soilslip than a rock or landslide.

In another locality in the San Juan, namely, the C. H. C. Hill, near the town of Rico, progressive slipping is actually in effect at this time. At one point the stump of a tree has been split open since the tree was felled, and the two portions have separated about five feet in a period of four years. The crack was traced for some hundreds of feet. It is suggested

THE SLID-OFF FACE OF LANDSLIP MOUNTAIN, SHOWING THE SHARP LINE OF DEMARCATION WHERE THE SLIDE BEGAN

that similar cracking and subsequent saturation may have started the Cimarron slide.

Cross and Howe, in a reconnaissance of Ute Creek, a tributary of the Rio Grande, in 1903 found evidence of a landslide that had occurred in comparatively recent times, intermediate in character between that of the Cimarron slide and the incipient slide near Rico. The area covered by the Ute Creek slide is about one-fourth of a square mile, and while no trees appeared to have been actually thrown down as a result of the slip, most of them had been disturbed and stood at considerable angles from the vertical; the trunks of many were buried for several feet by fine sandy soil, which stood in steep slopes in an extremely unstable condition. Although this soil was dry, the horses sank into it so deeply that they were extricated with no ltitle difficulty. The general condition of the locality suggested that a series of heavy rains might so saturate the soil as to cause a renewal of the movement with a violence comparable to that of the Cimarron landslide. So we may hear of more "earthquakes" in the San Juan region, with possible destruction of mining towns.

TREE SPLIT BY LANDSLIDE MOVEMENT NEAR TOWN OF RICO

This area may be preparing for a general landslip

THE MOST TERRIBLE ROCK AVALANCHE IN HISTORIC TIMES

To realize the terrific effect of recent landslides, when associated with human activities, one must turn to the accounts of such catastrophes as the great Elm landslide in Switzerland in 1881, or the Frank slide in Alberta in 1903.

The town of Elm is the highest village in the Sernf Meadow. Overshadowing it rose the steep Plattenbergkopf, the outmost buttress of a greater mountain mass. About half way up this hill was a fine slate bed, which was mined in a careless manner for school slates. A crack began to form above the mine, steadily widening, and splitting the top of the hill. It grew to be over 12 feet wide, swallowing up all surface drainage. Every one seemed to have agreed that the mountain would ultimately fall, but no one thought the danger imminent. Rocks began to fall at intervals. September 11 was a rainy Sunday. Rock masses kept falling, and the mountain groaned and rumbled. People gathered at the foot of the laboring rocks to watch the falls. Many were interested, but none foresaw real danger. Yet the villagers then stood viewing an impending convulsion that not all the human engineering ability in the world could avert.

Suddenly a mass of the mountain broke away from the Plattenbergkopf, crashed down over the slate quarry and spread out upon the flat. No one was killed by this fall, though the rocks

ROCK STREAM AT HEAD OF SILVER BASIN, SILVERTON LANDSLIDE AREA.

Showing concentric wave-like formation resembling lava flow, which is characteristic of many rock streams

reached within a stone's throw of where the sightseers were gathered. The people of the upper village now became mildly alarmed. This first fall came from the east side of the Plattenbergkopf; seventeen minutes later a second and larger rock mass crashed downward from the west side.

The gashes made by the two united below the peak and left its enormous mass isolated and unsupported. Then four minutes later, as if pausing only to catch its breath for the final plunge, those who were watching the mountain from a distance beheld the whole upper portion of the Plattenbergkopf—10,000,000 cubic meters of rock—suddenly shoot from the hillside. The great mass pitched downward with tremendous velocity until it reached the quarry. Then the upper part shot forward horizontally straight across the valley and up the opposite hill slope.

A cloud of dust accompanied it and a great wind was flung before it. Trees were blown about like matches and houses lifted through the air like feathers and broken up as though little toys by its force alone.

The avalanche, shooting with incredible swiftness across the valley, struck the opposite hill slope obliquely, and was immediately deflected, like water, down the level and fertile valley floor, which it covered in a few seconds to the distance of nearly a mile and over its whole width with a mass of rock debris 30 feet deep.

Most of the people who had run up onto the opposite hillside were killed instantly. Only when the avalanche had struck this slope and begun to turn aside from it did the people in the lower village, far down along the level plain, have any suspicion that they were in danger. Twenty seconds later all was over, and the rock torrent had swept away half that village. The sharp edge of the avalanche cut one house in two. All within the fatal edge were destroyed; all without were saved. One or two men had a race for life and won, but most who were in the path of the destroyer were doomed.

In brief, 12,000,000 cubic yards of rock fell about 1,500 feet, shot across the valley and up the opposite hillside to a height of over 300 feet, then deflected and poured like a torrent over a horizontal plane, covering it uniformly throughout a distance of 5,000 feet and over an area of 1,000,000 square yards, to a depth of from 6 to 65 feet. Before the avalanche there lay a peaceful village and fertile green fields; within one minute a solid gray rock carpet had been spread, beneath which rested the remains of 150 human beings, their houses and their fields, while the familiar Plattenbergkopf had vanished and a great hole was in its place. Few were the wounded requiring succor, and few the dead whose bodies could be recovered.

Those who witnessed the catastrophe from a distance hurried down to look for their friends. One such was Burkhard Rhymer, whose house was untouched at the edge of the debris. He ran to it and found the doors open, a fire burning in the kitchen, the table laid and coffee hot, but no living soul was left. All had run forth to help or see, and had been overwhelmed—wife, daughter, son, son's wife, and two grandchildren. Such was the rockslide of Elm.

THE GREAT FRANK LANDSLIDE

Only slightly less dramatic and quite similar in character to the Elm rockslide, was the one which partially swept the town of Frank, Alberta. By a hair's breadth only did the community escape complete annihilation. This slide was of much greater magnitude than the Elm disaster, although not so many people were killed.

Turtle Mountain, the scene of the avalanche, is a lofty, narrow ridge situated about 14 miles east of the Continental Divide, and is surmounted by a number of rocky peaks. The range is pierced, north of Turtle Mountain, by a narrow gap, through which flows Old Man River. Near the gap, and where the valley is broadened by the debouchment of Gold Creek, and close to the foot of the mountain, nestles the town of Frank, an

ROCK STREAM OF IMOGEN BASIN, SILVERTON AREA

Three-quarters of a mile long. Note packtrain ascending trail along its edge

important coal-mining center. The mountain itself is an exceedingly precipitate series of cliffs of limestone, sandstone, and shale rising over 3,000 feet above the river.

At dawn on April 29, 1903, a huge rock-mass nearly half a mile square, and from 400 to 500 feet thick in the center, suddenly broke loose from the mountain and crashed with terrific violence into the valley beneath, overwhelming everything in its course. The great mass, broken into innumerable fragments by the fall, plowed through the river bed, crossed the valley and hurled itself up the opposite slopes to a height of 400 feet. Within a minute or a minute and a half over a square mile of pleasant valley was covered with a rock-flow from 3 to 150 feet deep. Most providentially the greater portion of the town lay outside the course of the slide; nevertheless, 70 people were killed.

One man, hearing the noise of the rock-fall, rushed to the door of his house in time to see the slide flash by, only a few feet in front of him. Its passage seemed practically instantaneous. Another man, hearing a great noise, looked in time to see the fall of the mountain and almost instantly the spread of the material over the valley like a viscous fluid. Yet some of the rock pieces constituting the "flow" are 40 feet square. A gang of coal miners was entombed in the coal mine by the stoppage of the entrance by the debris, but they dug themselves out through the roof.

Two and a half miles were traversed by the slide, from the top of the creek on the mountain to the foot, while the material dislodged is estimated at 40,000,000 cubic yards. This is over three times the size of the Elm slide. While it is believed that the coal mining in the valley may have hastened the slide, the primary cause was undoubtedly the structure of Turtle Mountain. The huge mass was in a state of unstable equilibrium, and possessed a weak base.

Although this great slide was a sufficient catastrophe to make men gasp throughout the land, especially those living with overshadowing mountains as their daily companions, it might have been far worse. But one peak of Turtle Mountain slipped. The steep shoulder of the mountain which looks directly down upon the town of Frank stood firm. Had this, too, gone, the entire community would have been smashed to atoms in the twinkling of an eye, and none left to tell the tale.

Moreover, there is likelihood that such a catastrophe may happen at almost any time. The town of Frank, according to the Canadian Geological Survey,* might exist on its present site uninjured for ages, but there will always be a possibility of a second destructive slide. The fact that the north shoulder withstood the shock of the first slide is no proof that it is too solid to fall. Almost the same conditions exist on the north peak and shoulder today that obtained in the central peak before it broke away. Unusually heavy rains, rapid changes of temperature, a slight earthquake, or falls in the coal mine at the base of the mountain following the closing of the chambers, perhaps long after the people have lost all dread of the mountain, may snap the supports which retain this huge mass in place and precipitate it upon a career of destruction compared to which that of the recent slide would be child's play. The suggestion seems a wise one that the people of Frank move a short distance up the valley to a point of safety.

* Report great landslide at Frank, Alberta.

SCENE IN MANCHURIA, ON THE ANTUNG-MUKDEN RAILWAY

MUKDEN, THE MANCHU HOME, AND ITS GREAT ART MUSEUM

By Eliza R. Scidmore

Author of "China—The Long-Lived Empire," "Jinrikisha Days in Japan," "Winter India," "Java—the Garden of the East," etc.

MANCHURIA is a country as large as Texas or as large as France, but the Manchuria that the world knows—and it has only known it for these fifteen years—is a little stretch of seacoast, the Liaotang Peninsula, and the valley of the Liao River, the latter a fertile region some 30 miles wide and 900 miles long.

From the time when Shunche, the Manchu chief, was invited in through the "First In-Going-Gate in the World" to assist the rebels in their revolt against the Ming emperor—and the Manchus ousted him and sat down upon the Peking throne themselves for 250 years—nothing ever happened in Manchuria until the Japan-China war, the Boxer outbreak, and war again put it in the forefront of the world's interest. It promises to hold the stage for another decade or two, and is a storm center of world politics.

China has done next to nothing to develop or defend these three eastern provinces beyond the Great Wall, wholly outside of the eighteen provinces of China proper, although, as the early home of the Manchu rulers, Manchuria should have been the chief jewel in her cap. All has been impermanence and change in Manchuria during these fifteen years of stress and storm, and the rapid change of officials, from viceroy to lowest minion, has been the only policy of the distracted Manchus at Peking.

MANCHURIA AND KOREA ARE OVERRUN WITH TOURISTS

Since the war, travel has followed in the steps of the victorious army, and General Kuroki was unconscious advance agent of an army of tourists—a forerunner of scores of independent expeditions in search of excitement, the picturesque and the unexpected—something never seen before. The grand detour from the grand tour of the world now is—from Japan across the narrow straits to Fusan, in Korea; thence by train to Seoul; and from Seoul to the Yalu River, and on to Mukden, precisely following in Kuroki's footsteps. There is an American standard-gauge railway, with American cars, locomotives, and rails across all of Korea, and he travels in comfort to the Yalu's banks. Those historic banks are lined with the rafts of timber floated down from the headwaters of the Yalu, and are about to be linked with a great railway bridge.

From Antung, on the Manchurian bank, a toy railway, a Decauville tram line, of two-foot gauge only, traverses the 180 miles of rough, mountainous country to Mukden. This is the famous Antung-Mukden Railway, with which yellow journals filled their frenzied columns in 1909, between the adjournment of the tariff Congress and the discovery of the North Pole. After Doctor Cook came home, Antung-Mukden affairs were forgotten, and only by fits and starts did the yellow journals declare that the peace of the world and the rights of an army of American merchants and miners were imperiled by the Antung-Mukden convention concluded between China and Japan. That has since been shown to be a simple and innocuous arrangement between the two governments directly concerned, and officially declared so by our Department of State.

This comical little railway was laid by General Kuroki's troops to bring up their

supplies as they marched across from the Yalu to Liaoyang. After the war, it continued to run as it was, with terrific grades, switchbacks instead of tunnels, and rolling-stock of the simplest. It was intended to maintain communication only until such time as the improvements being concluded on the main line of the South Manchurian Railway, there should then be chance to reconstruct the line, make it a real railway, give it a few tunnels and some rolling-stock. The work is now in hand, and will be completed in 1911.

It traverses a most picturesque country, all hills and valleys and winding rivers—an old country with ruined fortresses and pagodas, valleys packed with waving crops, and terrace culture to the hilltops. The few adventurous tourists who have made the trip in the funny little springless cars, who have survived the hotel at Antung, and forgotten the half-way house in the hill country where one night was spent, are enthusiastic over the region.

THE JAPANESE HAVE RECHRISTENED DALNY

Dalny, "far away," has been rechristened Tairen, and is a wonderful place. De Witte's city has felt the touch of Japanese progress and sanitary science, while the Good Roads movement, the Village Beautification societies may find object lessons there. Tairen has changed its face as well as its name, and is a city redeemed, where the steam roller has rolled continuously for three years, and heard the rolling of other steam rollers as they progressed over the beds of broken stone that are fast transforming Kwangtung mud sinks and clay bogs into smooth park roadways. A film of green on the hillsides shows where afforestation's miracle has begun its work.

The Russians left their droschkies, the Japanese brought their jinrikishas, and have since provided electric cars, more luxurious and up-to-date than some of the green chariots that are propelled through the streets of Washington.

The Japanese are not pulling the jinrikishas, driving the vehicles, or doing any such manual labor in Manchuria. They are the employers of labor—and labor in unlimited supply comes over from Chefoo. Fifty thousand husky Shantung coolies cross over to this land of silver and opportunity as to a lesser America each year, and return after the harvest is gathered and outdoor work is suspended for the winter.

A CITY OF EXPERTS AND SPECIALISTS

Tairen is a city of experts—of high-priced experts and specialists in all technical lines—and nearly all of them are graduates of American institutions. Brick works, cement works, mills, and factories fringe the town, and a palace of a bank, as splendid as anything in Washington, gives the humblest all the marble, and mosaic, black iron and plate glass a depositor is supposed to want. A wonderful Japanese laboratory at Tairen is always discovering something for the benefit of Manchuria, undertaking new and stimulating and increasing the older industries of the province.

The insatiable young scientists and technologists assure one that, after beans, wild silk or pongee is the future great crop of Manchuria. The silkworms, fed on the leaves of oak trees instead of mulberry, produce the thread for pongee or tussur silk. Besides the steadily increasing demand for pongee as clothing in China, Europe, and America, pongee is the best material for the wings of flying machines and the bodies of dirigibles, and the Chefoo market was stripped last year after the great flight of the aeroplane across the English Channel. As we will all be flying on wings of pongee in a few years, it becomes a matter of interest that the world's supply of pongee should be increased.

Beans are the great crop, however, and by beans alone Manchuria could live and supply the world. The bean plant should be the crest, the symbol, the coat-of-arms of Manchuria. It is a fortunate thing that there is one great food crop that never fails, and that can be depended upon to feed us when land gets too scarce

THE LATE EMPRESS DOWAGER AND SOME OF HER ATTENDANTS

to plant it in America, and wheat flour is the food of kings. Along with the banana, upon which we shall all be supporting life in a few generations, and, after the kaoliang or giant millet, beans are the most prolific crop. Thirty varieties of these soy beans grow in Manchuria, but the black and the yellow are the valuable oil-producing varieties. They have always been sent by tons by junks to south China for food, fertilizing, and illuminating, and a little to Japan. After the China-Japan war of 1895, when the Japanese commissariat learned their value for man and beast and crops, the exportation to Japan increased three times, replacing, fortunately, the failures in the herring fishery that year as a fertilizer. General export continued to increase until, in 1899, beans, bean-cake, and bean-oil were exported to the value of $12,000,000, and in 1909 the value was nearly $75,000,000.

THE GREAT BOOM IN BEANS

Tairen harbor was crowded all last winter with waiting ships. One hundred ships at a time lay at anchor waiting their turns, ten at a time, at the stone quays, and loading went on day and night.

The beans, when ground and pressed, yield 10 per cent of oil, and the refuse, compressed into great cartwheel cakes weighing 60 pounds and more, provides the best of all fertilizers for the rice-fields of Japan and the sugar-fields of Formosa, the Philippines, and even Java. The beans are converted into soy and bean curd in both Japan and China, and furnish those two popular articles of food—soy, the dark brown, pungent sauce resulting from a fermentation of bean dough. This bean soy is sent to England and America by the shipload, and, when treated to cayenne pepper, becomes our familiar red-labeled Worcester sauce. Bean curd, or bean cheese, is a

THE LATE EMPRESS DOWAGER IN HER IMPERIAL YELLOW DRESS

ANOTHER VIEW OF THE EMPRESS DOWAGER, TAKEN AT THE SAME TIME AS THE PRECEDING PICTURE

A CHARACTERISTIC EXPRESSION OF THE LATE EMPRESS DOWAGER

common and most nourishing article of food, popular with all the people, and is a clean and most attractive looking dish.

The Japanese, with their mania for investigation and analysis, have found that the liquid left from making the bean curd, and which used to be thrown away, has the same chemical value as milk, and is, of course, many times cheaper.

Europe at present uses the beans for making candles, soap, and dog biscuits, and as an adulterant for other flours. The oil is a substitute for olive oil that threatens to displace our cotton-seed imitation of olive oil.

Beside the great Japanese firm of the Mitsui, who started the boom in beans by their gigantic transactions, several English firms, including the representative of the Rothschilds and several German firms, have gone into this bean export business, and have established bean mills or oil mills and built godowns on a large scale—the open door quite satisfactorily open to them. Before the war, the beans were carted to the river bank in winter, when the ground was frozen as hard as a road, and sent down to Newchwang by junks. The trade by junks has not fallen off, and this enormous railroad freight

to Tairen, and to Vladivostock as well, and foreign shipment only represents the development of the province since the last war.

The new tenants, or rather the old tenants, on their return cleaned and tidied Port Arthur, paved the streets, and made the place a model of sanitation and order. Every wreck has been raised and sold, every bit of scrap iron dredged up from the harbor, every fragment of the dead interred with honor.

Port Arthur affords a day or two of the most tragic sight-seeing one can endure. A good carriage road connects all the dismantled forts and another leads to the Two Hundred and Three Meter Hill, the world's most awful slaughter-ground. A great mortuary temple has been built to the spirits of the dead on the high hill facing the harbor entrance, and also a great column to their memory, built with the granite blocks taken from the blockading ships which Hirose and his fellows sunk at the harbor entrance—that ballasting of their ships with their own tombstones the last word of the wonderful Japanese prearrangement.

At Tairen one meets the butterfly crest of the South Manchurian Railway, and thence northward "the company" is all in all. The letter M, whose loops are suggestive of a butterfly's wings (the butterfly being one of the Chinese symbols for good luck, long life, and immortality, and a favorite art motif), and the profile of a cross-section of a rail, greatly resembling the Chinese character for industry, compose a monogram that greatly delights the Chinese eye and mind. One soon gets bewitched with this butterfly crest of the South Manchurian Railway, as he sees it on every locomotive, car, and piece of railway property, on the uniforms of employees, even to the patterns of the kimonos and neck-folds of the little waitresses at the railway hotels.

BUILT OF AMERICAN STEEL RAILS AND EQUIPPED WITH AMERICAN CARS AND LOCOMOTIVES

The railway, 440 miles long, without a single tunnel, was a mere track, without bridges or rolling stock, when the Japanese acquired it as almost the only prize of the war. They floated a loan of $100,000,000 at 5 per cent and double-tracked the road with steel rails from Pittsburgh, equipped it with Baldwin locomotives from Philadelphia, Pullman cars from Chicago, and spent many more millions in the purchase of railway materials in America, as they are again about to do for the Antung-Mukden Railway. Beside paying 5 per cent interest on this loan and 6 per cent on the stock, the South Manchurian Railway reaps a surplus each year. Receipts are increasing by leaps and bounds, partly owing to the wonderful bean trade and to the opening and working of more and more coal mines—coal that is said to be second only to Cardiff in quality.

Because of its Pullman sleepers and dining-cars, and its long day coaches, American travelers have only words of praise for the railway, and European travelers sneers and open complaints. The Russians and Belgians loudly jeered at the Pullman cars, with their great expanse of glass windows, and said that they would never do in a Manchurian winter, being ignorant of just how many hundreds of such glass coaches daily traverse our most northern and western States and all parts of Canada through the blizzard season. The Japanese have also introduced the American baggage check into Manchuria; but, as the connecting railway across to Tientsin and Peking is of British ancestry, and the Trans-Siberian is a law to itself, the excellent example is not likely to spread.

When I checked my trunk from Tairen to Mukden, I held on to the check and the South Manchurian Railway held on to the trunk until I was ready to take train on to Peking. Then the trunk was tossed into an open truck, and third-class passengers roosted on it like so many chickens, any one of whom might have carried it off at any way station.

This British-built railway has dining-cars, a little less splendid than the Pullman-descended ones on the South Manchurian Railway, and the Chinese, with

THE GIANT MILLET FIELDS OF MANCHURIA LOOK LIKE OUR OWN PRAIRIE STATES

their childlike frankness and directness, call them "kitchen cars"—for one may dine, *i. e.*, eat, in any and every car, but you can only cook in a kitchen car.

LIKE OUR PRAIRIE COUNTRY

Nearly all of Manchuria that one sees from the railway is covered with crops of giant millet, and the short millet, which is the same as our sorghum. The giant millet, under the primitive culture employed, repeats itself 3,000 times and the short millet 800 times, so that even scientific agriculture can teach little to the Manchus. Giant millet grows 10 and 12 feet high, and can conceal a man and a man on horseback. This kaoliang furnishes food and fuel and distilled drink, mats for the floors and for a thousand economies of farm life, and the stalks, daubed over with clay, provide a good building material. When stacked in the autumn, kaoliang gives the landscape much the look of our prairie country. In fact, these vast flat fields of kaoliang stalks need only the pumpkins and James Whitcomb Riley to be exactly Indiana.

The poppy fields of Manchuria, covered for solid acres with billows of soft pink or white blossoms, are more beautiful than the tulip fields of Holland; but, with the growing moral sense and the rule of reform, the poppy must now disappear and the ground will be given up to the harmless and profitable soy bean.

As one journeys across the prairies of Manchuria, past Haicheng, Liaoyang, Shaho, and Hunho—names of burning interest five years ago, when the great armies were halted before Mukden—no sign of war or battle remains. As far as one sees are luxuriant fields of beans and sorghum and newly-built houses, the very newness of their mud walls significent of the utter waste and desolation left on that same plain when the two armies had gone by. In such vast levels one cannot understand how any one could know, not seeing, where the battle was going on or what the combatants were doing—a battle-field of all-out-doors, with no strategic point greater than a gully.

A CITY OF DIRT

Liaoyang is the oldest capital of the Manchus, but the war has given Liaoyang its only interest for the tourist.

THE GORGEOUS STREET SIGNS OF MUKDEN: THE MAIN STREET AND BELL TOWER
(SEE PAGE 301)

One rides into the walled city and around its slummy streets on the most comical man-power tramway, two small benches on a tiny truck, some poles and cotton curtains constituting the standard rolling-stock. A husky Manchu in a loose dressing gown of wadded cotton, long, flopping trousers, and cotton shoes runs and pushes the clumsy toy for a while, and then jumps on and enjoys the ride until "the old cat dies," and he has to speed her up again. When one meets another special on the single track both cars stop, exchange their passengers and return on their same routes, the passenger paying another five cents at each transfer and at most switches.

One is jolted around the uninteresting, unpaved streets, with their blank walls and poor shops, avoiding innumerable head-on collisions, until he reaches a mountain of rubbish, a hillock of garbage, ashes, and brick-bats quite 30 feet high in the very heart of the city—a fitting altar to the deity of Dirt, which the Liaoyang people seem to worship with their whole hearts. From this lofty scrap-heap, as from the city walls, one sees the whole panorama of the battle plain, surrounded by low hills that were ideal for purposes of defense, "if the defenders could throw stones," one American officer said, after a tour of the battlefield. Yet the two armies shot away more ammunition in those three days than the combined French and German armies used during the whole war of 1870!

The Japanese children in the settlement can point to the strategic spots in the great plain—where Kuroki came out from the hills; where Kuroki cut through and was cut off for hours; where the Russian retreat began—and tell how the Russians fled, setting fire to the mountain of stores they had to leave behind, and burying cases of champagne, music boxes, and other delightful munitions of war for their pursuers to resurrect at their leisure one whole winter long.

A SHOE SHOP IN MUKDEN (SEE PAGE 302)

The Chinese show where the Russians deliberately breached and entrenched on the city walls, using the parapets for gun platforms and rifle trenches, inviting and drawing the enemy's fire into the peaceful city, packed with helpless non-combatant country folk, in addition to the terrified city folk—almost the most cruel, most wantonly cruel, act of the whole war.

DUST-STORMS WHICH HIDE THE SUN AND CHOKE MAN AND BEAST

The railway to Mukden does not get there—that is, to Mukden—not by three miles. In the original concession to the Russians it was not to come within 20 versts of the old home of the Manchu chiefs, but the exigencies of war brought the rails closer than that. It is a long, uninteresting three-mile ride through a one-story suburb from the gray brick station marked "Mukden" to the gates of the real Mukden, the permanent camp of the all-conquering Manchus.

Russian droschkies and Japanese jinrikisha and ancient horse cars from all parts of Japan, soon to be succeeded by the most modern of electric trams, carry one about Mukden, and the two-wheeled cart of the country is only for country folk and freight nowadays. The Japanese macadamized the roads up to the city gates and a shame-faced governor did the rest for the main streets of the inner city.

The long ride to and from the station is a penance, whether in the scorch of midsummer or the below-zero of winter, or in the dust-storms and rain-storms which rather evenly divide the days of the milder seasons. And it can rain at Mukden, especially in September. Torrents every day; deluges every night!

When it does not do that, the wind blows, rudely, fiercely, and, beginning far away in the desert of Gobi, sweeps up the solid earth and carries it along in clouds that fill the air, hide the sun,

choke man and beast, and penetrate every crevice and pinhole, until all the outer world and indoors is an inch deep with gritty brown dust. After the summer deluges and dust-storms there is a long and bitter winter.

A shabby dagoba, with crumbling images and peeling ornaments, a group of dilapidated temples up a mud bank, and some new temples, which have in turn served as Russian and Japanese military offices, and now shelter the American consulate, mark the way toward the iron grille, which replaces the tumbled-down gate tower in the outer city wall. Half way to the gate of the inner or Tartar city another temple, whose gateway and guardian lions are islanded in a reflecting lake after every rain, is falling to ruin on one side of the highway; and, on the other side, other tumbled-down temples show Buddhism in its last decaying stages.

A MANCHU SAMOVAR (SEE PAGE 302)

PICTURESQUE MUKDEN

One-third of Mukden's people claim to be Mohammedans, forswear pork, take many baths, and prostrate themselves toward the west at every sunset; but the mass of the townsmen have no religion at all, modern, material progress and foreign example having shattered the old creeds and left neither hope nor fear in their place, giving them no new code or standards. "Better Buddhism than this," said one despairing evangelist.

Mukden, the permanent camp of the all-conquering Manchus, is an epitome of Peking—a smaller Tartar capital, with a lesser palace in an inner city, with ancestral tombs to north and east. It is a picturesque and fascinating place, its street crowds brilliant in color, and its street signs the most bewitching and fantastic decorations any Manchu can imagine.

There is local color to exaggeration—color on the carved and gilded shop fronts and street signs, color in the costumes of men, women, and children, and color of the most violent, vivid cerise on the women's cheeks, and on the peonies, chrysanthemums, and sunflowers set in bouquets at either end of their towering "double-loop" head-dresses. When the sun shines on an every-day Manchu street crowd it presents the gayest carnival scene. What it may be like in Mukden streets on high holidays and great festivals, I am ready to travel there again to see.

Mukden has its drum tower and its bell tower like Peking; each keep a

BACK VIEW OF THE HEAD-DRESS

FRONT VIEW OF THE HEAD-DRESS OF MANCHU WOMEN
(SEE PAGE 305)

grand cross-roads, where city life centers and gay street signs are thickest; each keep a solid old three-story tower with faded red columns and shabby old green-tiled roof.

Order of the most rigid kind is maintained in Mukden streets by flat-chested police and sentries, who wear top boots and semi-foreign uniforms, their queues coiled in psyche knots under the brims of their girlish sailor hats or upturned turbans. Rifle in hand, they have taught the public that street traffic is no longer a go-as-you-please affair, and the husky Manchurian cart driver follows the rules of the road as abjectly as the lately-tamed cab driver of New York. The local levies have learned military style and manners from two grand armies of occupation and re-occupation, and the people learned well their lesson that the man with the gun was not to be trifled with. When they severely nod the traffic to right and left, the carters no longer bellow and bluster, but obey.

WHITE FOX AND SABLE SKINS (SEE PAGE 302)

A SPLENDID RACE OF STALWART MEN AND HANDSOME WOMEN

Once through the deep-vaulted gateway of the Tartar city or citadel, color and picturesqueness surround one, and the streets are moving pictures of Manchu life—the life of brave horsemen and strong northmen, of bold hunters and fighting tribesmen, but lately come from nomad life on broad, dry plains to this permanent camp with its high brick walls. The Shantung people, in their dull clothing, are not numerous enough to spoil the picture.

These hearty Manchus, descended from northern Tungusic Tartar tribes, are a different people from the soft, sleek, languid, lemon-tinted yellow men of the steamy rice fields of the south—the common Chinese of commerce, the strictly-excluded, emigrating Cantonese who alone are known in the outer world. Their cold, dry northern winter has made men of these Manchus, given them backbone, brawn and "sand," sinews and muscles of iron.

Their women, when protected, are creamily instead of greenishly yellow. The Manchu women walk free and untrammelled on their natural feet, and their fine Manchu eyes are set straight in their heads, their eyelids not caught together at the corners. They, with their long robes of brilliant colors and their tremendous head-dresses, add the last, best touches to the brilliant pageant of street life—streets whose carved and gilded shop fronts, with gold and vermilion "beckoning boards," are as gay as any in south China.

THE GORGEOUS SHOP SIGNS

Mukden's streets have an additional glory in the shop signs, that make gorgeous cornices, shoot from the door-

posts, and stand on tall masts outlined against the sky. Golden scepters and dragons sprout from the eaves, horses, unicorns, and peacocks perch there, and gods and goddesses, fiends, and fairies jump from gigantic flower cups and ride on mythical monsters, along with every other fantastic and highly-colored thing Manchu fancy can invent. Besides these, there are the gigantic images of the articles sold within—hats, beads, pipes, and Brobdignagdian boots that dwarf the shopkeeper who stands beside them.

There were many more fantastic shop signs along the streets before the Boxers burned the rich shopping quarter in 1900, and after the rebuilding many of the new signs had to be moved to inner courts when the telegraph poles were erected, and many more put out of sight when the streets were paved.

One must lament any such sacrifice of picturesqueness to the demon Progress, and I begged the governor of Mukden to offer prizes for the most gorgeous shop signs of each year, to reward such public benefactors by an omission or reduction of taxes.

City life centers around the mediæval bell-tower and drum-tower that block the main street and make busy four corners of gossip and trade, and fend off the evils of the north from the palace. The rich silk shops and fur shops are near these old towers, and in the autumn every other shop is a fur shop. Fur coats, fur robes, and dressed skins are hung out and piled up on the counters of the open-fronted shops, along blank walls and on the ground.

Pursuing side streets and narrow alleys of bottomless mud, and crossing untidy courts, we found the storehouses of dealers in sable and ermine—second and third rate reddish-brown Manchurian sables and the superior dark, smoky-brown treasures from beyond the Amur—all put at the preposterous prices dealers dream of getting from strangers and greenhorns.

There are many shops for the sale of foreign goods, many more than drew the fury of the Boxers in 1900, and the popular fancy now seems to run to our enamelled tinware—pink and blue tea kettles, and, choicest of all, rose-du-Barry and turquoise wash basins that are always put last on the top of the big wicker market basket with netted cord cover, which is the most *chic* piece of luggage that a great personage carries on his railway travels.

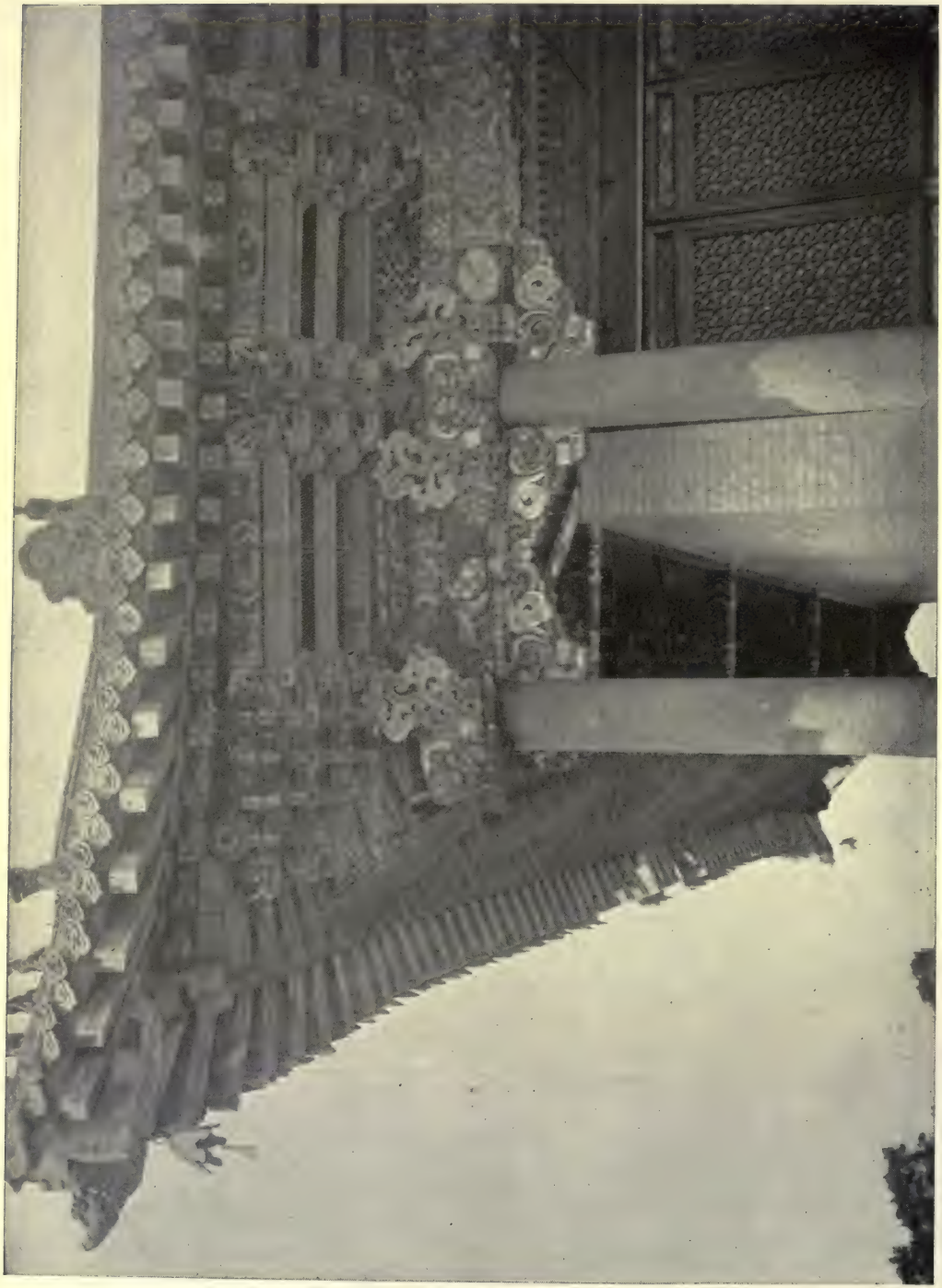
THE MANCHU SAMOVAR

The viceroy and the governor ride in "glass carriages"—broughams with windows on all sides in Shanghai style—and the first automobile has come, in the shape of a steam roller that parades the streets and snorts in the lunettes of the old red gateways, whose tiled roofs wave with weeds and bushes, and have archaic cannon niched in quiet corners. Progress, with a very large "P," blares its presence when two young men in enormous spectacles drive up and down the main street in a real American buggy, clanging the gong of a police or hospital ambulance.

Far better to the eye is the two-wheeled Manchurian cart with three mules straining at the traces ahead of the shaft animal, and a soft, boomy bell sounding from under the body of the cart, instead of being hung on the animals' necks. When these carts are filled with country women rouged to the eyebrows, and their headdresses set with sunflowers, Mukden shows one street sights unequaled outside of the three provinces.

There is a purely Manchu samovar to be seen at every tea booth and street restaurant in Mukden and in Peking, which is plainly of the place and the race, and undoubtedly parent of the samovar, which the Russians did not have in Russia before the Tartar raids and conquests. The Manchu samovar burns wood, coal, charcoal, grass, and anything that comes along, and the shining, graceful, copper or brass body, with its beautiful and unmistakable Persian lines, has any sort of an iron or tin chimney thrust down its throat to draw the

DETAIL OF GATE-HOUSE OF IMPERIAL PALACE: GREEN FAIENCE DRAGON PANELS ON BRICK COLUMNS (SEE PAGE 305)



DETAIL OF RAFTERS AND BRACKETINGS OF THE PALACE EAVES OF THE IMPERIAL PALACE

smoke and flame up through the hollow core. In the early morning and at the noon "rice-time" these great water boilers are fired up freshly, and send out clouds of cheering smoke and steam. For the rest of the day they simmer gently, always ready to pour a bubbling stream into the teapot. They are forged and hammered out in the brass bazar, a narrow street opening from the main street, and the ear is the only guide needed for one who would find the place.

THE MANCHU WOMEN ARE THE MOST STUNNING FIGURES IN ALL ASIA

The Manchu women are the most stunning figures in all Asia, and the tall *lian-barh-to* of Manchuria is the most magnificent head-dress I have ever seen. In the last decade the *lian-barh-to* has mounted and spread, until it is a towering, gabled affair that stands eight and ten inches above the smooth, blue-black head, the golden cross-bar wound with loops of black satin instead of hair. The simple guan-zan of the old Empress Dowager, balanced across the head and held there by loops of hair, has broadened as well as mounted, and its ends droop like railway signal arms. If they did not, it would be impossible for a Manchu lady to enter a house door or a cart without turning the structure sideways.

This exaggerated Merry Widow affair is so heavy that women must remove it indoors, and they cannot walk facing the wind nor turn on their course without certain scalping. On rainy and on dusty days this magnificent structure of satin and flowers, tinsel and jewels is shrouded in a cotton cloth, and their brilliant silk robes and gay little jackets are hidden in long sheath garments straight and tight as bolster cases or Parsee's coats.

To see the Manchu women in all their glory in the sunshine, I stayed on day after day in the Mukden hotel, sufficient test and proof of admiration and appreciation. That "Astor House!"—the Mukden-Astoria!—where all the rooms were back rooms, dark and damp, and the place cheerless enough in the rain to drive any one to suicide! Where the tourists came raging down from Harbin every midnight, to sleep on the floor as long as there was any floor space left—and where the tourists came raging up from Tairen at daylight, berating the universe and the fate that had landed them breakfastless in such a dilemma at the end of the long drive from the railway station—raged madly as only tourists will, until that genius of a French cook, lately turned hotel proprietor, always dressed in military khaki, gave them such a midnight supper or morning coffee that they thanked their ancestors that they—and he—lived.

A SILVER CHEESE

The palace of the Manchus, as built in 1656, was doubtless a very simple affair. It was rebuilt in 1750 by Kienlung the Magnificent, a very Louis XIV for splendor, a Cosmo de Medici for learning and love of the arts. Kanghsi and Kienlung and the early great ones of the Manchu line revisited the ancestral home often in those days, when traveling meant something. They came to Mukden once in every ten years, at least, to thank their ancestors, to worship the tablets, to make offerings and to deposit the dynastic records, bringing with them gifts and treasures of every kind to the rarely occupied palace, until it became and remains a great storehouse of eighteenth century art—an Art Museum bursting with incredible treasures.

There was the theory that the Manchu rulers were preparing against a rainy day—preparing against any chance of fortune sending them for refuge to the old home—and there was a fable that they stored solid treasure there against the time when the next conqueror should push them from the dragon throne at Peking. They did not send bags of loose coin to be sifted along the highway. Even the bars and shoes of silver bullion were not put in final storage in any such convenient shape.

The Manchus knew themselves—that is, their own people; and, as the fable goes, they took an old dry well in the

THE DRAGON THRONE, MUKDEN PALACE: THE DAIS COMPLETELY COVERED WITH PILES OF IMPERIAL YELLOW PORCELAIN BOWLS AND PLATE (SEE PAGE 309)

palace compound and set up a mud furnace at its edge. Then, melting the ingots, they poured the treasure down the well until it was full to the curb with a solid cylinder of pure metal. They cemented that well over and filled another and others with more bullion in safe cold storage.

When the rainy day should arrive, the Manchus were to retreat to Mukden, and, chipping away at the silver treasure, nibbling at their precious silver cheese, live on in happy idleness forever after. In Mukden they scoff at this story of buried treasure, but one does not like to give it up. It is so plausible, so characteristic, so Manchu, that even Prince Ching might have devised it last week.

NEGLECTED FOR 100 YEARS

Tao-kwang was the last emperor to visit the ancestral home. After his stay in 1805 the caretakers assiduously neglected the palace, dusting out a corner or two every ten years, when the imperial prince, who could not escape the honor-

THE GREAT PAVILION OF THE IMPERIAL PALACE AT MUKDEN BEFORE THE REPAIRS

able penance of imperial proxy, came to bring the records of the preceding ten years to add to the ancestral chronicle, and to bring more precious things to the palace storehouses. Prince Ching was starting on that errand—but comfortably, in a through railway train, in October, 1908—to deposit the records of Manchu rule from 1898 to 1908! From the coup d'etat to the promise of a constitution! And a fine series of fairy stories the imperial historians must have concocted, too, to save face before the ancestors! For the bald, disgraceful truth about these last ten years would make the Manchu forbears rise from their grave mounds.

The red entrance gate and the pailows of honor admitting to the Chin Lan palace face the south gate of the Tartar city, and five courts on rising terraces lead back to the garden at the far north end of the compound. All the pavilions, save the first audience hall, and the Hall of Worship, where the Emperor Taitsung died, have been nearly rebuilt in the

BLUE-AND-WHITE VASES, IMPERIAL YELLOW BOWLS AND PLATES OF THE PERIOD OF KIENLUNG

course of the very thorough restorations undertaken since the Japan-Russia war. Both armies respected the sacred precincts during the war. When the Japanese General Kodama came to visit the grateful viceroy after the peace, the latter asked his advice as to what he should do to improve his provinces and help his people, so long the sport of contending armies. "Pave your Mukden streets and make roads, so that your country people can bring their crops to market first," said the great military genius.

"What next?" asked the contrite viceroy.

"Well," said the candid friend, looking around at the sagging and weed-grown roofs, the broken windows, torn mattings and blinds — everything in the last stages of dilapidation and deeply dirt-encrusted—"if you Chinese had half the respect for your ancestors that you talk about you would never let this old palace remain in this condition. Clean it up. Repair it, or it will fall down on your heads in another year."

It was the year for plain talking and the visitor improved his opportunity, saying, incidentally, that he would repair the palace at the expense of the Japanese government, if the local officials would not do it, and charge it against the revenues of the province.

The viceroy commanded and the minions fell to with such zeal that when General Kodama came back six months later the place was hardly recognizable. To save face before the Japanese general they did what reverence for the imperial ancestors had not moved them to do for nearly a century, and, after a frenzied house cleaning, they painted, papered, mended, plastered, and slicked things over to a miracle. Chinese pride was roused to prodigies of activity, and, as pride grew and money was granted for the "sacred places," the later repairs have been entire reconstructions. "Clean and

LARGE BLUE-AND-WHITE KANGHSI VASES TEMPORARILY STORED IN TUBS AND COVERED WITH DUST: MUKDEN PALACE (SEE PAGE 310)

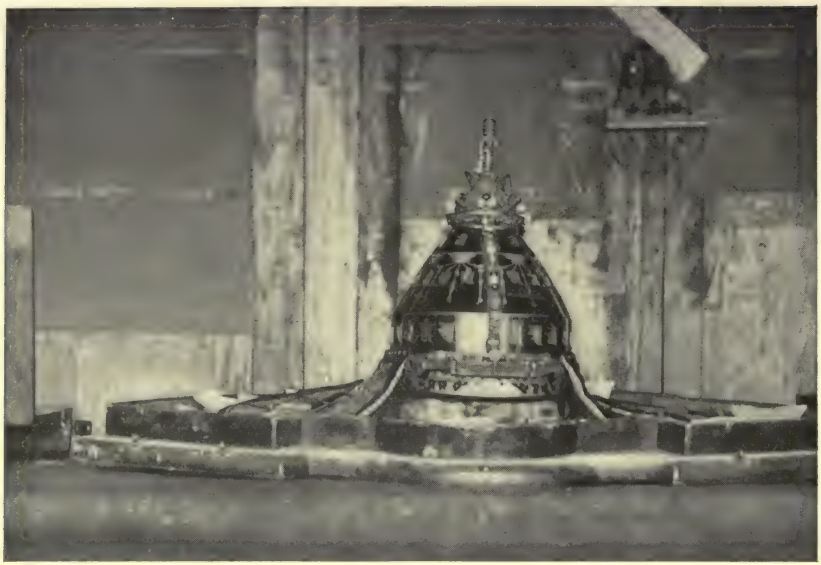
Peaceful," the inscription over the door of the pavilion which was the study of the Emperor Taitsung, is no longer a mirth-provoking legend to western visitors.

THE DRAGON THRONE

The audience hall is not as vast as the great temples of throne-rooms at Peking, but it is sufficiently impressive, and the red-raftered ceiling, with its fine ribbing and its great beams covered with rainbow decoration, gives excellent setting for the ornate ark sheltering the chair of state. The attendants tell one that it is the chair of Shunche, Kanghsi's father; and then they tell one that Kanghsi's successor, Kienlung, sent the chair from Peking—a much more likely tale, since it is plainly a replica of the "imperial seat" in the Pao Ho Tien, the great audience hall in the old palace in the Forbidden City at Peking.

The state chair is a mass of interlaced dragons carved to a miracle, covered with vermilion and gold lacquer, and stands on a dais approached by three stairways under a canopy supported by splendid dragon-wreathed columns. When the jeweled person of the great Kienlung sat upon that golden throne it must have been a sight to dazzle the eyes of the simple tribesmen who garrisoned the old citadel.

On either side of the audience hall are the great storehouses and the famous imperial library, and behind it is a terrace twenty feet higher on which stand the great palace pavilions, where the sovereigns lived and passed their hours of case and occupation. Chief of these is the great three-story tower where the Emperor Kienlung spent all his time during his Mukden visits—in the Manchu "old home weeks." It was in the most fearful state of dilapidation in



BLACK LACQUER JEWELED HELMET OF THE EMPEROR KIENLUNG

1905, but now, having been completely rebuilt, is practically the same thing of joy to the eye as when Kienlung first surveyed the completed palace.

All now is new, clean, and perfect, from the first red-latticed doors and rainbow beams under bracketed eaves to the last roof of shimmering yellow tiles, with scaly dragons coiled like rampant shrimps on the ridge pole, and dogs and lions parading down every angle to keep away evil spirits.

Wind bells of gilded copper swing from every angle of the tip-tilted roofs, and the restoration has been faithful and exact. In the side court, the two-story pavilion of the empress, the eunuchs' quarters, and a little study or library with quaintly gabled end walls, all glow with new tiles, latticings, fresh gilding, vermilion, and polychrome decorations on the broad beams and rafter tips. There are a few ceilings with square sunken panels, where golden dragons grin in coils, but others, like the audience hall, have timbered roofs, the rows of slender red ribs of rafters defined against a flat gold ceiling—a direct suggestion of the primitive lodge poles of their tented ancestors. Some wonderful old panels of glazed pottery with dragons and devices in high relief have been reset in walls and screens, and used in ornamental constructions in these courts.

The great imperial library of more than 6,000 cases of volumes, deposited by the Emperor Kienlung, is a duplicate of those also deposited at Peking and at Golden Island monastery, on the Yangtse.

THE MOST MARVELOUS COLLECTION OF PORCELAIN IN THE WORLD

The palace storehouses contain more than one hundred thousand pieces of porcelain of the best period of the imperial potteries at King-te-Ching. Tens of thousands of pieces of porcelain were sent up to the Peking palace every year, and the supply for Mukden was in proportion. The eastern storehouse, the Fei Lung Ko, where the thousands of vases, plates, bowls, and cups were kept, had so very nearly sagged to the ground by 1905 that it had to be completely rebuilt.

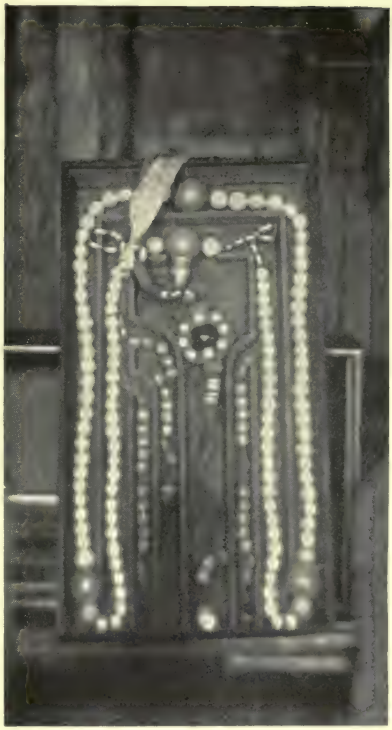
All this ceramic treasure was taken to the audience hall, where it covered the floor, the dais, and even the imperial

chair itself. In the side rooms large blue and white vases of the Kanghsi period were tumbled recklessly together in huge casks, without as much as a rag or a wisp of straw to protect them. Smaller vases were ranged on shelves in duplicates and duplicates of rare blue and white beauty past counting.

The throne room was only a grand palace pantry when I saw it, imperial yellow, powder-blue, and chicken-liver-red plates and rice bowls stacked all over the floor to the area of nearly an acre. All were dirt-encrusted and spider-webbed together in a way to make one gasp, and the attendants pottered around over and among this fragile treasure, sorting it and carrying out by the basketful to the court, where leisurely ones scraped off the first dirt crusts with twigs, and then washed the pieces to near-clean stages.

Things that are treasured in glass cases and satin-lined boxes in western museums were strewn all over the flagged court. When Tang Shao Ii was starting off on his spectacular tour of all great nations, he had permission to choose from this storehouse gifts for all the potentates and benefactors he was likely to meet. He chose for American gifts eight pairs of great ribbed celadon vases, some famille vert jardinieres, and some smaller celadon and sang de bœuf pieces, and a single peach-blow vase as the particular gift to President Roosevelt, who promptly sent it to the National Museum, where it is now on exhibition with other such official gifts from foreign rulers.

The Yale-graduate governor of Mukden listened to me with doubt when it was suggested that he offer this palace porcelain collection as security or collateral for any loan he might wish to raise for the colonization and development of Manchuria. He looked with more incredulity when it was suggested that a certain American banker might jump at it at two per cent, with such a collateral, and then pray and pray for a chance to foreclose.



ROSARY OR OFFICIAL NECKLACE OF LARGE PEARLS WHICH BELONGED TO THE EMPEROR KIENLUNG: MUKDEN PALACE (SEE PAGE 312)

TREASURES NOT TREASURED

The western storehouse, the Hsiang Feng Ko, is a still richer treasury. It contains personal relics of the Manchu emperors, a great accumulation of jeweled arms, ancient bronze mirrors, jewels, and precious stones, crystal, enamel, bronzes, and more than ten thousand paintings of the Ming and early Ching dynasty. All is kept without much order or care in big red cupboards, closed by padlocks as large as a hand, and sealed with strips of paper that the keepers paste on and lift off with their long talons of finger nails with a simple ingenuousness that is startling, considering the tales of craft and graft and villainy that run up and down the empire and the incredible value of the contents of those cupboards.

NORTHERN TOMBS: MUKDEN

They seem to have the strongest feeling for the money value of these treasures and relics, and give one plain figures when they produce the great seals of Kienlung—a pair of solid gold cubes four inches square, with crouching, dragon-like tortoises run through with imperial yellow cords, the characters of the imperial cypher cut sharp and clear.

They show one the imperial yellow satin robes of Kienlung, embroidered with the finest gold thread, the dragons worked in seed pearls; his overcoat of plum-colored satin, with more gold thread and seed-pearl dragons; his Mogul helmet of black lacquer encrusted with gold, set with pearls and rubies; his diamond-hilted Indian daggers and his jade-handled swords

Best of all is his rosary, or official necklace, of one hundred and eight half-inch pearls. The four "regent beads" of this rosary are *lapis lazuli,* the pendent "disciple strings" are coral, with large sapphire "dewdrops" at their ends. The reliquary, or central medalion, has one huge, burning ruby in a circle of creamy button pearls, and a last and largest pear-shaped pearl hangs from that cord.

Fully one-third of these large pearls are dead—dull and lustreless. They have been lying there untouched, unworn, shut away from light and air in the satin-lined box for more than a century.

Everything is Kienlung's in Mukden and in its palace. Kienlung did this and that, built the city walls and towers, the palace and the mortuary temples without the walls. Kienlung deposited the great treasures there, the collection of paintings that is alone of its kind as an imperial possession, and the library that the Chinese were always fearing the Russians might seize and carry off to St. Petersburg. One almost grows weary of Kienlung with the incessant repetition of his magic name, but no other emperor ever impressed himself upon Peking as did this great one—shadows only, names merely, those others.

The Russians built a very splendid administration building that would be a fine prefecture in any European city, and Tang Shao Ii, while governor of Muk-

THE EMPEROR OF CHINA, HENAN TUNG, AND HIS BABY BROTHER

den, built himself a greater brick palace in foreign style in an incredibly short space of time. The viceroy of Manchuria has been much in the lime-light since 1900, and remains a conspicuous satrap of the empire.

When I saw the viceroy and his suite at a Japanese fête at Tairen, whither he had gone to pay a state visit, I was convinced as never before of the common origin of the North American Indian and the Chinese or Manchu-Tartars. There might as well have been Red Cloud, Sitting Bull, and Rain-in-the-Face, dressed in blue satin blankets, thick-soled moccasins, and squat war bonnets with single bunches of feathers shooting back from the crown. Manchu eyes, Tartar cheek bones, and Mongol jaws were combined in countenances that any Sioux chief would recognize as a brother's.

THE TOMBS OF THE MANCHU ANCESTORS

The tombs of the Manchu ancestors are in two great parks, the one to the north and the other to the east of the city. Tung-Ling, the eastern tombs, are the most extensive, the grove of gnarled cedars surrounding them the oldest and most impressive. In the face of all the talk of ancestor worship, the sacred burial place is sadly neglected, and the enclosures unapproachable after any heavy rain and often cut off from the world for weeks at a time by deep mud sloughs and gullied water courses untended for a century. Any pretense at a road, any vestige of the imperial highway that once existed, has long ago been swept away and forgotten by Kienlung's degenerate descendants, who have so misruled and so nearly wrecked his empire, bringing it again to the stage of decadence it had reached when Confucius strove to awaken the rulers of his day.

The Peiling, the northern mausoleum, where Taitsung is buried, is less than five miles from the city wall, its groves of cedars and yellow-tiled roofs visible

THE EMPEROR OF CHINA, HSZAN TUNG

PRINCE CHUN, THE REGENT OF CHINA, WITH HIS TWO SONS:
THE EMPEROR HSZAN TUNG STANDS BESIDE THE CHAIR

Photo and Copyright by Underwood & Underwood

GRINDING THE GRAIN, MANCHURIA

The illustrations accompanying this article, unless otherwise indicated, are from the author, Eliza R. Scidmore

across the level plain. They are the Ming tombs in miniature, noble pieces of eighteenth century architecture and decoration, a long series of gate towers, courts, and pavilions leading to the tower of the imperial tablet, immediately before the simple earthen mound. The brilliant colors, the red walls, green and yellow tiled roofs, rainbow bracketings, and vermilion eaves are all softened by time to the mellowest bloom and tones.

There is an avenue of stone animals and guardian figures, as at the Ming tombs, and at the top of the steps of the last of the marble terraces a broad doorstep, a solid slab of jade (green-veined jadeite), leads to the hall of worship.

Both armies respected these tombs during the war, and their venerable cedars were the only trees spared on the whole plain. The Russians did maintain an outpost at the gates and stabled horses in some of the outer green-tiled buildings, but that was taking a great risk with really fine horses, as the roofs were then leaking and leaning almost to the point of collapse.

THE MANCHURIANS DID NOT SUFFER MATERIALLY BY THE WAR

There are no signs of war or battle on any of this great Mukden plain, this vast Manchurian outdoors, covered with rich crops of kaoliang, beans, and corn. Only the bayonet spire on Putiloff Hill, far to southward, a Japanese memorial column,

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PAGODA GATE AND TOWNSPEOPLE OF MUKDEN

Photo and Copyright by Underwood & Underwood

THE DRUM-TOWER AND THE EXTRAORDINARY SIGN-POSTS IN THE PRINCIPAL STREET: MUKDEN (SEE PAGE 301)

Photo and Copyright by Underwood & Underwood

BEAUTIFULLY SCULPTURED STONE ARCH BY THE TOMB OF AN ANCIENT MANCHU EMPEROR: MUKDEN, MANCHURIA

Photo and Copyright by Underwood & Underwood

FINE PAGODA GATEWAY ENTRANCE TO THE MANCHU EMPEROR BAYLING'S TOMB

speaks for the million men who lay at arms all of that one winter, and for the silent thousands who remained.

When fugitives and pursuers disappeared to northward, and the incessant din of cannonading ceased for the first time in six months, the country people crept back to the places where their homes had been. Nothing of their houses remained, and their fields were filled with pits and trenches and dugouts where the troops had hibernated.

Marshal Oyama gave all the quarters, the dugouts, and their contents to the peasant owners of the soil, and, by the end of March, the little communities had reassembled and were busy with spring plowing. They soon rebuilt their wattle and dab houses, their mazes of mud walls that mean safety, propriety, and orderly life to them, and to this day the man with the hoe and the man behind the plow are turning up unexploded shells in their fields. As they always open any such strange finds with a stone or a hammer, the mission hospital is never without some such gunshot case in its wards.

In the large sense, the province did not suffer materially by the war, for, while the people were driven from their homes, their property seized or destroyed, and payment rarely made to them for such losses, the presence of those two great bodies of troops stimulated all industries, and gave employment at high wages to thousands who would otherwise have been idle through the winter months.

Altogether, the two armies spent more than four hundred million roubles for provisions, clothing, labor, and transport in the province, although sums equivalent to their individual losses did not always come to the same sufferers. The townswomen made money beyond all their dreams by sewing on the fur and wadded garments required for the Russians.

Country women and children shared in this silver shower, and the keen Manchu middleman reversed the old advice, "*eplucher le mandarin*," and plucked the Russian, cruelly, to the last.

Photo by A. C. Barlor, Chicago

ON THE ISLAND OF CAPRI

Photo from Paul Thompson

A RELIGIOUS FESTIVAL PARADE AT PALERMO: THE CAR OF THE BLESSED VIRGIN

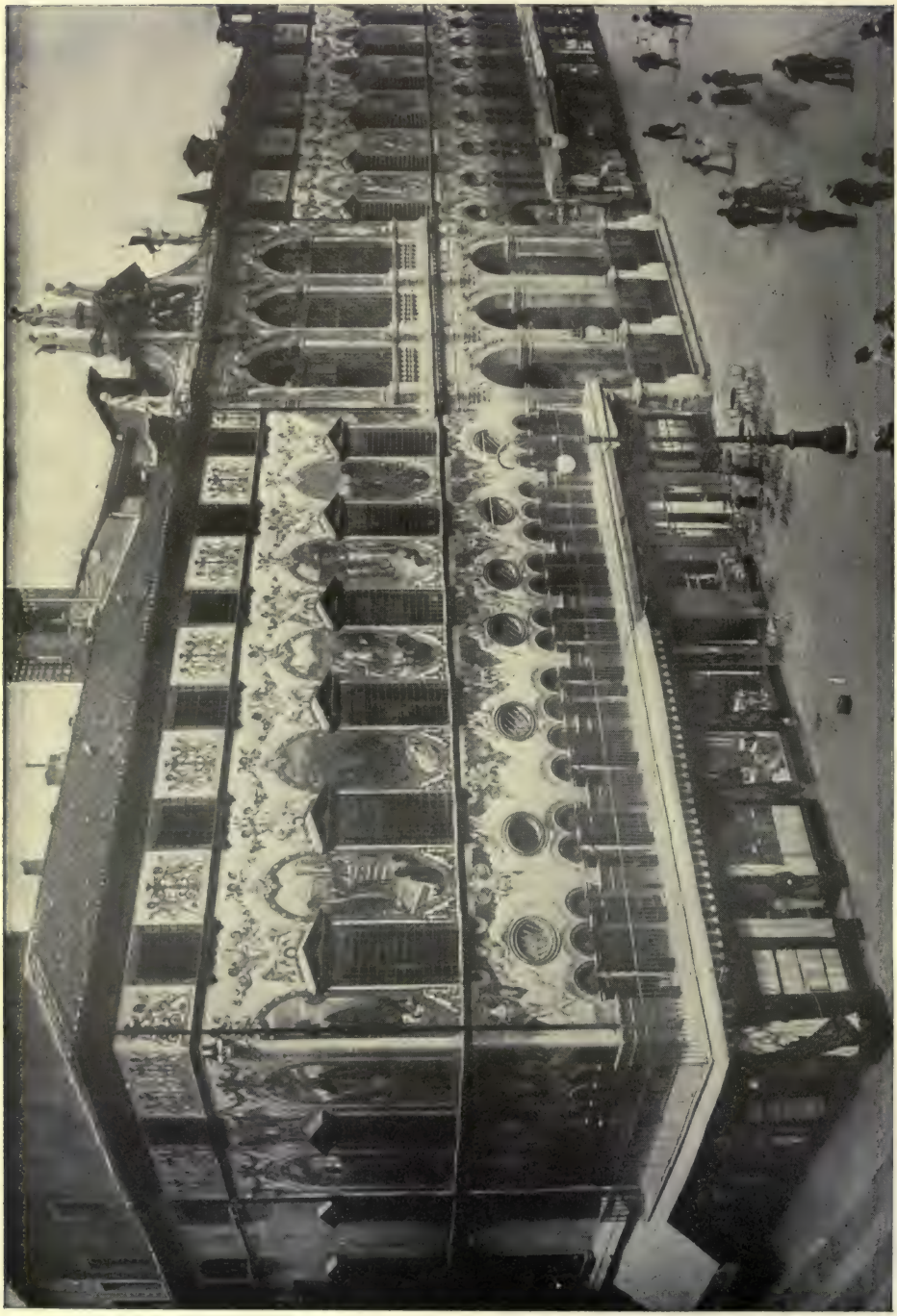


Photo from Paul Thompson

ONE OF THE GRANDEST FRESCOES IN ITALY, ON THE PALACE OF THE MONT DE PIETI, IN VENICE: PAINTED BY THE FLORENTINE ARTIST, BRUSCHI

These very alarming persons are not, as might be supposed, night riders or vigilantes surreptitiously disposing of a victim, but men from all stations in life who have come at the call of a bell to help convey some unfortunate to the hospital. These Italian "Brethren of the Misericordia" are laymen who do penance or fulfill some vow by serving as stretcher-bearers in carrying the sick, burying the dead, or collecting alms for charitable purposes. The society has been in existence some hundred years, and this peculiar garb was adopted as disguise, for the cardinal principle is to conceal their identity from each other and the public.

This is one of several very beautiful China medallions of babies by Andrea della Robbia, which adorn the outside walls of the old Foundling Hospital built by the silk-workers of Florence, Italy.

THE CERTOSA OF THE VAL D'EMA IS BELOVED OF ALL TOURISTS IN FLORENCE, ITALY

It stands like a fortress on a hill, an afternoon's drive from the city. Within its garden is this beautiful old well. Around lie the graves of monks. In the gardens were cultivated flowers and herbs, from which the brethren distilled their Chartreuse and sweet perfumes. The monastery is now closed and the monks all gone but one or two who linger on suffrance and sell the perfumes to Americans.

Photo from Paul Thompson

A MARBLE QUARRY, CARRARA: PREPARATION OF A CHARGE OF DYNAMITE TO DETACH A BLOCK OF MARBLE FROM THE MOUNTAIN SIDE

Photo from Paul Thompson

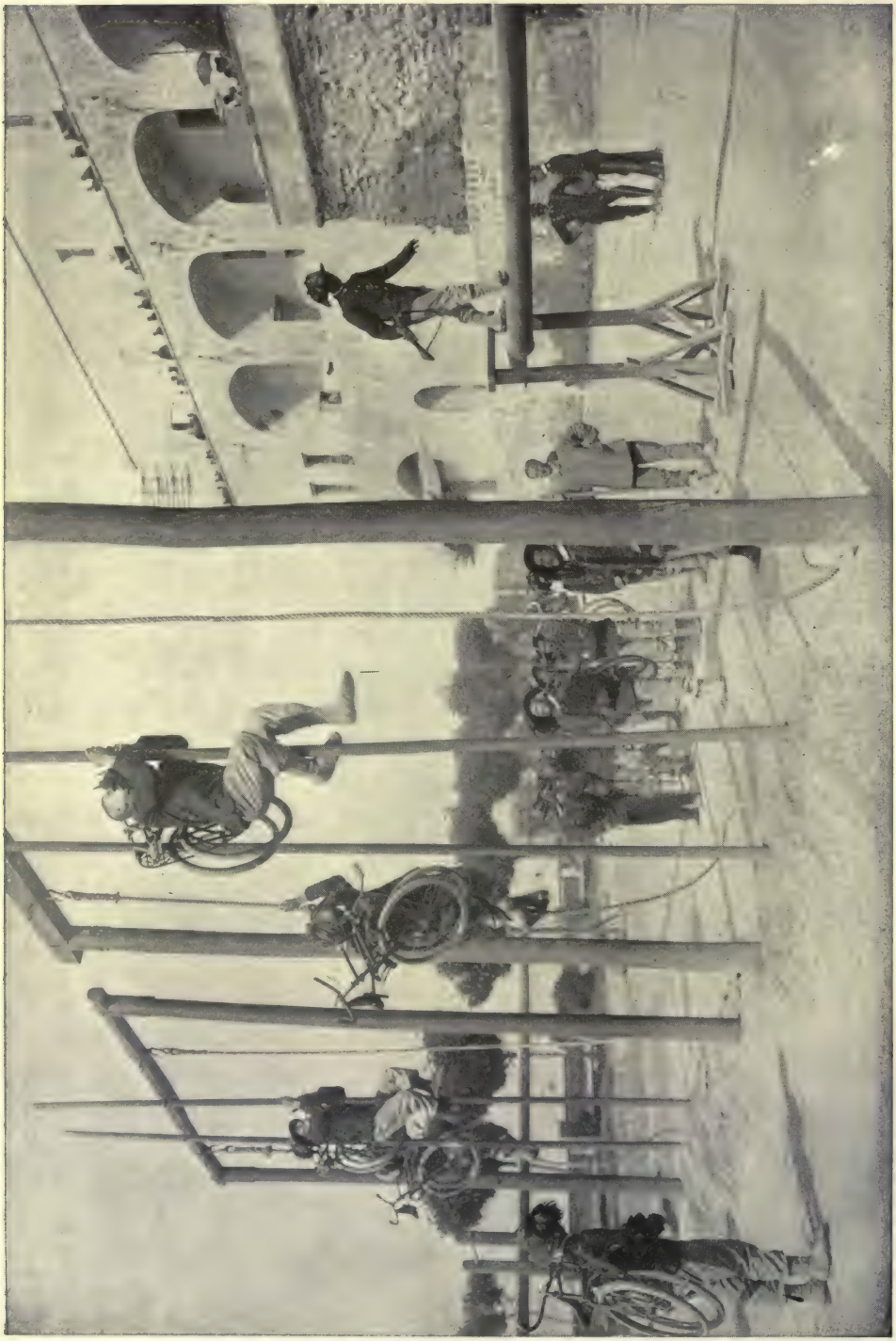
CUTTING A BLOCK OF MARBLE TO ORDER: CARRARA

THE PICTURESQUE SETTING OF THE CARRARA MARBLE-WORKERS' LABORS Photo from Paul Thompson

Photo from Paul Thompson

OXEN DRAWING A BLOCK OF MARBLE THROUGH THE STREETS OF CARRARA

Carrara owes its fame and prosperity to the marble hills which surround the town; 5,000 men are employed in the neighboring quarries to cut and ship the beautiful white Carrara marble, which is sent to all parts of the world to be carved into exquisite statuary.



THE CYCLE CORPS OF THE CRACK ITALIAN CAVALRY REGIMENT

Photo from Paul Thompson

Photo from Paul Thompson

ITALIAN SOLDIERS CLIMBING A GREASED POLE

Photo by A. C. Barlor, Chicago

THE LEANING TOWER OF PISA, BUILT OF WHITE MARBLE

The view from the top, reached by 300 steps, is wonderfully beautiful, embracing the Carrara and Apuan mountains, the city and the blue sea

THE SPIRIT OF THE WEST *

The Wonderful Agricultural Development Since the Dawn of Irrigation

By C. J. Blanchard, U. S. Reclamation Service

THE spirit of the West is optimism and progress. It is the spirit that fired the hearts of our forefathers who erected in the primeval forests of New England the superstructure of the greatest nation on earth. It is the optimism and faith which imbued their descendants who carved an agricultural empire of unparalleled richness from the Mississippi Valley.

Once a wilderness so unpromising that it evoked derision in the halls of Congress, the West has become today the land of fortune and opportunity. In this land of boundless distances the altitude is stimulating, the air is a tonic, giving health to the infirm and courage to those who have failed elsewhere. Its constant sunshine encourages optimism and cheerfulness. The glories of its opal-tinted dawns, the indescribable beauty of its sunsets, and the nameless witchery of its twilight softly melting into night are the work of a divine painter.

There is mental and spiritual uplift in its mountains, whose summits are in regions of perpetual snow. Its sapphire lakes, excelling in beauty those of Switzerland, open up a wondrous field of interest and pleasure to the sight-seer and those in search of rest and recreation. The monarchs of its forests cast their shadows on the earth before the coming of the gentle Nazarene.

Its canyons, sculptured during uncounted centuries by wind and wave, are unrivaled in their wonderful and varied coloring and in their awe-inspiring depths.

Its deserts, in vastness of area, in potential wealth of soil and climate, and in rivers of constant supply, are sleeping empires awaiting exploitation and development. Here nature offers to every man his birthright—a wide sky, the sunshine, the wind, and a sure reward for intelligent effort. Here things are writ in characters too vast for human pen.

It is our own land of mystery and enchantment, of crumbling ruins, and of lost races which have vanished utterly.

On the lofty mesas of the painted desert are "tribes whose ceremonies bridge the years between ages of stone and steam," living antique lives in a modern day. Their houses are fortresses erected a hundred years before Columbus sailed the unknown western seas. On their walls the watchman still holds vigil, and in their kivas strangely clad priests recite their prayers, which may antedate those of our own religion.

The late Governor John A. Johnson well said the West symbolizes "homes for the homeless; food for the hungry; work for the unemployed; land for the landless; gold for the penniless; freedom for the enslaved; adventure for the restless; dangers for the brave; an unknown world to conquer, and room for all."

Irrigation has wrought its miracle, and 13,000,000 acres reclaimed are annually producing harvests valued at more than $250,000,000, and supporting in homes of their own more than 300,000 families. The wealth of that portion of the country which great statesmen in Webster's day were wont to declare worthless is greater now than that of the entire nation in 1860.

In the swift march of national events during the past decade, the development of the West has focussed the attention of the world. It furnishes one of the

* For previous articles on this subject by the same author see "Winning the West," February, 1906; "Millions for Moisture," April, 1907; "Home-making by the Government," April, 1908; "The Call of the West," May, 1909, Nat. Geog. Mag.

THE WAY THEY ADVERTISE THEIR MARVELOUS CLIMATE AT YUMA, ARIZONA

A climate where crops ripen every month in the year, and a region remarkably like that of the Valley of the Nile

most inspiring pages in the annals of our commonwealth. It is a story of progress and human achievement—a battle with nature in her sternest and most forbidding aspect.

Future writers will record the irrigation movement as an epoch in our history the far-reaching influence of which overshadowed in importance any other progressive movement since the opening to settlement of the Mississippi Valley. The reclamation of vast areas of our arid and semi-arid regions, which is being promoted by the Federal Government and by large corporations working in conjunction with several States, is of profound economic importance to the nation.

The additional opportunities thus created for homemakers are already serving to check the undesirable efflux of the country people to the city. Millions of acres of desert, unleached by rain and storing in its bosom the fertility gathered there by centuries of washings from hills and mountains, are being quickened by life-giving waters.

Cities, populous and great, have sprung up; rural communities, attractive and prosperous, broad vistas of fertile fields, and blossoming orchards whose yields are prolific beyond comparison, replace the wastes of sand and sage-brush.

Economic forces are at work today in the country, and particularly in the arid West, which are gradually but surely shaping our agricultural development along new lines. In many parts of the irrigated country agriculture now occupies a position of greater dignity among the vocations than ever before. Its place among the scientific professions is now recognized and it is calling more strongly every day for the best talent and brains the nation affords.

Agriculture in the desert is intensive and calls for and encourages a higher degree of intelligence than is found in humid regions. Farms are small and settlements are compact. There is constant interchange of ideas among the farmers, whose relations become intimate in the transaction of daily business.

Individualism, which is a characteristic of the farming regions of the East, as well as provincialism, are less known in the irrigated sections. The irrigation canal is the connecting link which binds the community together.

This great public utility is controlled and operated for the common benefit. Coöperative management of the irrigation system is a fundamental principle on each of the Government projects. The inevitable tendency of such management has been coöperative organization, which today is extended to all the farmers' activities — individual, educational, and social.

Gradually there has grown up a desire for betterment of conditions, and with the coming of ample financial returns there is evidence of a desire to improve the character of home life. The country is becoming citified, and life on the irrigated farm is growing attractive. The isolation and loneliness of farm life where farm homes are far apart are eliminated.

Farm life and its duties under these conditions are regulated today very much the same as the man of business orders his affairs. The old haphazard methods of agriculture have no place here, where every acre must be made to give its maximum yield, and where the crop itself is carefully considered with regard to markets and cost of production.

There are today in the irrigated West a dozen or more rural communities which in artistic and beautiful homes, or in the nearly ideal conditions of home life enjoyed by the people, have no rivals in the East.

As new communities rise, provision is made at once for the educational and religious needs of the people. The centralized graded school is growing in popularity, and is being established in many sections. The children are carried to and from the school in carriages. Elementary agriculture is being taught, and an effort is being made to inculcate in the child a love of nature and a respect for life in the country.

The daily newspaper keeps the farmer in touch with the outside world and its

THE ROOSEVELT DAM: TYPE RUBBLE MASONRY ARCH GRAVITY (SEE PAGE 360)

Maximum height, 280 feet; length of crest, 1,080 feet; contents, 326,000 cubic yards. Below the dam is the power house where 7,500 horse-power is developed. In the nearer foreground is the transformer house and transmission towers

TRANSMISSION LINE THROUGH THE ROUGHEST PART OF ARIZONA TO CONVEY POWER FROM THE GREAT ROOSEVELT DAM TO THE SALT RIVER VALLEY

The character of the country traversed by the transmission line of the government is clearly shown

HAYING SCENE IN THE STRAWBERRY VALLEY, UTAH, ONE OF THE MOST BEAUTIFUL VALLEYS IN THE WEST (SEE PAGE 355)

Alfalfa is the farmer's bank account in the arid country

markets; the circulating library introduces the best literature into his home; the trolley lines now being extended through many irrigated valleys bring the city to his very door.

Throughout the arid West there is evidence of an orderly arrangement of detail and a planning of duties which in time will give us office hours on the farm. When crops are intelligently diversified there is little of the back-breaking, heart-discouraging work of the old time one-crop farm. Crops ripen and are harvested at different intervals, giving the farmer and his family ample time without crowding. Where harvests are sure and there is no interference by reason of rain, the farmer can apportion his time and his work with some degree of accuracy.

It is remarked everywhere in the West that the mental attitude of the farmer has undergone a pronounced change. The factors of better roads, rural delivery, telephones, trolley lines, coöperation, and frequent association with neighbors are primarily responsible.

For several years nearly all professions, from bootblacks in Butte to steeple-climbers in New York, have been organizing, except farming. Acting alone, the farmer has been for years at the mercy of the commission man or the elevator company.

In the irrigated valleys of the West today there have been perfected a number of strong and successful business organizations for handling special crops. Fruit-growers' associations in several districts are marketing crops each year valued at millions of dollars, and, largely as a result of up-to-date methods, have secured control of the best markets of the world for their products.

The success of these organizations, the opportunities they offer for first-class business ability, as well as the assurance of profits in agriculture, have excited widespread interest among many city-bred people, and have drawn thousands back to the country who could never have been induced to leave the city to take up the old system of farming.

The agricultural colleges report among their students an increasing number of city-bred youths who are perfecting themselves in the advanced lines of agriculture and horticulture preparatory to taking up the profession of farming.

The Reclamation Service began its work in 1902 on the passage of the Reclamation Act. The first contract was let in September of the next year, and, on June 17, 1905, an important project in Nevada was formally opened.

GIGANTIC TASKS ACCOMPLISHED IN FIVE YEARS

Progress has been rapid and the activities of the bureau have been extended to 26 or more projects, which to date have involved the expenditure of $60,000,000. In the seven and one-half years of its work the Service has built 4,215 miles of canal. Placed end to end, these canals would reach from Washington to San Francisco and back to New Orleans. Several of these canals carry whole rivers.

It has excavated 17 miles of tunnels.

Before the end of the year it will have completed four of the highest dams in the world. Its excavations of rock and earth amount to the enormous total of 60,000,000 cubic yards.

Its roads have a total length of 417 miles; telephones, 1,127 miles; levees, 70 miles.

It has purchased 915,751 barrels of cement and has manufactured in its own mill 340,000 barrels. As a result of its work, water is available for 750,000 acres on 13,000 farms.

The gross value of crops produced on the lands irrigated by the Government projects in 1910 was $14,038,000. As a result of the work of the Government it is estimated that land values have increased more than $105,800,000.

The Reclamation Service is entering 1910 with money and plans for completing most of its larger and unfinished masonry structures, and with about three-quarters of a million of acres of arid land under irrigation.

It will finish this year the great Roose-

TOMATOES GROWN ON THE JAMES WARNER RANCH, NEAR SPANISH FORK, IN THE STRAWBERRY VALLEY, UTAH (SEE PAGE 355)

POTATOES GROWN ON THE A. J. SMITH RANCH OF THE MINIDOKA PROJECT, NEAR RUPERT, IDAHO

Representative of the first crop of potatoes on this project

THE SITE FOR A GOVERNMENT RESERVOIR: UPPER MEDICINE LAKE, IN THE STATE OF MONTANA

velt dam in Arizona, one of the most massive in the world. It has completed the Shoshone dam, in northern Wyoming, the highest structure of its kind ever built; the Pathfinder dam, in southern Wyoming, and the Laguna dam, in Arizona. It will for the first time utilize the Gunnison tunnel, whose completion was celebrated by President Taft last summer.

The funds available for construction are somewhat less than in previous years, and the organization, which is very elastic, has been cut down to fit reduced expenditures. About 50 skilled men—engineers, experts, and technical assistants—have either sought private employment, have been transferred to other bureaus of the Government, or put on furlough, in order to keep the overhead charges consistent with the expenditures.

Reviewing the history of the Reclamation Service as a whole, its maximum activity and expenditures were in the year 1907. In 1902 the expenditures were less than $100,000, and in 1903 less than $1,000,000. In 1904 they were $2,500.000; in 1905, $5,000,000; in 1906, a little less than $10,000,000; in 1907, nearly $14,000,000. Then the expenditures decreased to $10,000,000 in 1908, to about $9,000,000 in 1909, and in 1910 they will be a little under $8,000,000. It is expected that in 1911 they will shrink to about $7,000,000, which sum will probably continue to be available during after years, assuming that the water-right charges are paid as they fall due.

If Congress should make a loan to the fund it would, of course, be possible to increase or even double the outlay and finish extensions of various systems in half the time otherwise required.

This is the most critical period in the history of national irrigation since the passage of the Reclamation Act, in 1902. By public notices of the Secretary of the Interior, issued last year, hundreds of water-right installments, involving approximately $1,000,000, became due on April 1, 1910. That date is a memorable one, not only to the settlers, whose entries are liable to cancellation for failure to make the payments due, but also to the Reclamation Service, which is concerned in securing the return of its investment in the engineering works. It is also a matter of interest to citizens of the number of sections containing feasible projects, the construction of which cannot be undertaken without additional funds. As the repayments are made through the local land offices and not directly to the Service, some time must elapse before the actual amounts collected are known. On a number of the projects, like Sun River, Shoshone, and Huntley, the settlers have already made their initial payments, and will not be delinquent on the second installment until April, 1911, which enables them to market two crops between payments. On several other projects, such as the Minidoka, Klamath, Lower Yellowstone, Belle Fourche, Carlsbad, Truckee - Carson, North Platte, and others, the first settlers have had the use of water for two crops, and it is probable that a majority will be able to meet their obligations without difficulty.

Detailed reports from various sources on each of the projects have been received at Washington. The conditions as a whole are described as favorable for a large return to the Reclamation fund. On several of the projects there will be no delinquents. On a number of projects the engineering work is not fully completed, but water is ready for large areas, and is being supplied on a rental basis pending the announcement of the actual cost of water right. The Reclamation Service has derived considerable revenue from these sources, and at the same time the farmers have been enabled to increase the areas in cultivation. The following financial statement is interesting as showing the status of the Reclamation fund and the amounts which thus far have been credited to it through the operations of the Reclamation Service:

Total moneys received and transferred to the Reclamation fund from sales of public lands under Reclamation Act to February 28, 1910, $58,342,617.02. Ap-

SIR KAAN MERCEDES PAUL, BORN JULY 14, 1904: WEIGHT, 1,800 POUNDS, AND VALUED AT $1,000
Owned by Dr J. C. Kloever, Yakima Valley, Washington. Exhibited at the Yakima fair

A BAND OF OSTRICHES COMING DOWN TO VIEW THE NEW CONCRETE TURNOUTS ON A LATERAL IN THE SALT RIVER PROJECT, ARIZONA (SEE PAGE 359)

proximately $4,500,000 are still in the Treasury of the United States, but not yet available.

Moneys received under operations of Reclamation Act from all sources, in cash and credits, for work done, $2,379,475.04, divided as follows: Town-lot sales, $103,673.91; miscellaneous sales, water rentals, etc., $1,694,844.77; collections on water rights, $814,145.34. This does not include any of the moneys collected for the water rights which were due and payable April 1, 1910.

THE HIGHEST DAM IN THE WORLD

Among the several large projects, one of especial interest is located in northern Wyoming. When the springtime showers and sunshine fall upon the snowy peaks of the lofty mountains on the eastern rim of Yellowstone Park, a thousand streams will rush downward to fill to brimming the swift-flowing Shoshone River. An important physical change will occur at that time. The flood that once, unchecked and uncontrolled, swept madly through the rock-walled gorge, will beat itself to stillness against a massive wall of concrete with which man has blocked the canyon. A beautiful lake, 100 feet deep and covering ten square miles, will appear.

In this wonderful gash in the mountains, with perpendicular walls a thousand feet high, the Government has erected the highest dam in the world. It is a wedge of concrete 328 feet from base to top. Its height can only be appreciated when compared with that of some well-known structure. New York's famous Flatiron Building would not reach within 47 feet of the top of the dam, and the tip-top of the dome of the United States Capitol would fall short 21 feet of the parapet.

In the summer, when the crops are thirsty, the big gates will be opened and the pent-up floods will be released into the river below. Another dam, a low structure of concrete, will divert the waters through a tunnel three and one-quarter miles long into a canal which for 40 miles passes along the upper edge of a broad and fertile valley containing 150,000 acres.

Two years ago it was a desolate waste. Today it contains more than 200 farm-houses and three thriving towns. Ten thousand acres produced crops last year on this project. With 16 farm-houses along each mile of the main highways, the valley already has a suburban appearance.

More than 250 farm units of 40 to 80 acres each are now available to entry, and offer exceptional opportunities for men of moderate means to secure homes in a prosperous and growing country.

BELLE FOURCHE PROJECT, SOUTH DAKOTA

Close to the Black Hills, in South Dakota, lies the beautiful valley of Belle Fourche, containing 100,000 acres of grass-covered prairie. Many miles of canals have been laid across its level surface, and what was only a short time ago the finest free cattle range in this country is rapidly becoming a compactly settled agricultural community.

An impressive engineering feature of this project is the Owl Creek dam, one of the longest and highest earthen embankments in the world. This structure, now nearing completion, is 6,200 feet long, has a maximum height of 115 feet, and contains 1,600,000 cubic yards of material.

The reservoir created by it will be the largest lake in the State. By means of a deep and wide canal six and one-half miles long, the entire flow of Belle Fourche River is turned into the reservoir, to be taken out again in the irrigating canals, which will supply 100,000 acres in 1911.

On the second unit, containing 10,000 acres, opened to entry March 1, there are about 60 Government farms awaiting settlers.

MONTANA PROJECTS

The activities of the Reclamation Service in Montana have resulted in the completion of two large projects and the partial construction of several others. The present plans provide for projects in this State as follows:

A FAMILIAR TYPE: THE OPTIMISTIC PROSPECTOR

	Acres
Huntley	28,921
Lower Yellowstone	64,622
Sun River	276,000
Milk River	248,000
St. Mary	100,000
Blackfeet (Indian)	132,000
Flathead (Indian)	150,000
Fort Peck (Indian)	130,000
Total	1,129,543

The Huntley and Lower Yellowstone projects are completed, and an important unit of the Sun River project was opened to settlement in 1908. Actual construction has begun on all the other projects, except the Fort Peck. On the Flathead project several units have been completed and water is now available for 13,500 acres, which will be allotted to successful entrymen on May 7.

On the Sun River and Huntley projects there are first-class opportunities for homeseekers to secure farms for which the water is now ready. The Sun River project contains 85 unentered farms, and the Huntley project 224. With the present rate of settlement, however, both projects will be fully taken up before the close of the crop season of 1910.

BEGINNING OF THE GREATEST PROJECT OF THE RECLAMATION SERVICE: THE NEW CAMP AT ENGLE DAM SITE, RIO GRANDE VALLEY, NEW MEXICO

The Engle dam will create the largest artificial body of water in the world

COMMUNAL LIFE ON UMATILLA PROJECT, OREGON

A region of small farms intensively cultivated in high-priced products. In 1906 this was a sage-brush desert (see page 355).

U. S. RECLAMATION SERVICE CEMENT MILL, CONTRACTOR'S CAMP, AND THE ARIZONA GIANT CACTUS: SALT RIVER PROJECT, ARIZONA

Nearly 350,000 barrels of cement have been manufactured in this mill. It completed its work on April 28 at 4 p. m., having saved the government more than $650,000

While all the Government land on the Lower Yellowstone project has been entered, a considerable area of railroad grant land is available at a maximum price of $2.50 per acre. The development of the valley since the beginning of the work of reclamation has been very rapid, and the time is not far distant when it will be one of the most prosperous districts in the Northwest.

A HARVEST-FIELD 20 MILES LONG AND 6 MILES WIDE

In the southern part of Wyoming, where the North Platte River flows in a deep granite-walled canyon, another masonry dam has been erected. It rises 215 feet above bed-rock, and back of it there is a lake with a capacity great enough to cover Rhode Island a foot deep.

Located 45 miles from the nearest railway, its construction was expensive and difficult. All machinery, cement, and provisions for men and horses were brought over the long miles of sage-brush desert.

Down the river many miles another structure of concrete turns the stored water into a canal 95 miles long, whence it is conveyed to the gently sloping valley lands in Wyoming and Nebraska.

In the beginning of the work I visited the valley, and at one particular point I gazed over a broad stretch of prairie. Within the radius of my vision I could count only six farm-houses.

Last year, from the same point, I saw a harvest-field 20 miles long and 6 miles wide, and counted 600 homes. Today on the North Platte project there are more than 1,500 families living in homes of their own. The construction of this irrigation system has already increased land values in the valley more than $4,520,000.

THE MOST SPECTACULAR PROJECT IS IN COLORADO

Among the valleys of the western slope, two in Colorado have focused the attention of the citizens of the country for the past few years. These are the Uncompahgre and Grand valleys, in the drainage basin of the Grand River, the most important tributary of the Colorado River of the West. Situated on one of the main traveled transcontinental highways, in the midst of the grandest scenery on the continent, no section of the West is more generally known.

It is only within the past few years that the agricultural importance of these valleys has impressed itself on the public mind. Surrounded by a rich mineral zone, the development of mines served to obscure the far greater wealth which is hidden in a soil of wonderful fertility and in a climate adaptable for the production of high-priced crops.

In the Uncompahgre Valley the Government has one of its most spectacular projects. The progress of construction has been widely advertised. For several years two large forces of men have been burrowing night and day through a mountain 2,000 feet high and 6 miles thick, excavating a tunnel, one portal of which is in a profound canyon 3,000 feet deep and the other at the upper end of a broad and fertile valley. The work is nearly concluded; a great underground waterway 6 miles long and capable of carrying a whole river has been excavated.

President Taft, on September 23, 1909, presided at the formal ceremony. He placed a gold bell on a silver plate and the electric connection released the pent-up floods of the Gunnison, and its waters, passing through the mountain, flowed out upon the Uncompahgre Valley to fructify a thirsty desert. The tunnel is lined with cement, as is also the main canal for several miles.

The irrigable area of the Uncompahgre Valley is 140,000 acres, of which 36,000 acres were public at the beginning of the work. Approximately 15,000 acres are yet unentered, but are not at this time open to settlement. Due announcement of the opening of these lands to entry will be made through the public press when the canals are constructed to furnish water to them.

TRAMWAY IN THE TIETON CANYON AT CAMP NO. 1: YAKIMA PROJECT, WASHINGTON

Length of tram, 1,800 feet; elevation, 600 feet; 33 1/3 per cent grade utilized for the transportation of men and material in connection with the construction of Tieton Canal, which is laid along the upper edge of the canyon, Tieton unit (see page 356).

LOOKING DOWN INTO TIETON CANYON FROM LOWER HEADING OF TIETON TUNNEL, ON MAIN CANAL, THE RIVER LYING 600 FEET BELOW: YAKIMA PROJECT, WASHINGTON

THE HIGHEST DAM IN THE WORLD, THE SHOSHONE DAM, WYOMING, COMPLETED JANUARY 20, 1910: 328 4-10 FEET (SEE PAGE 346)

Creates a large reservoir which will serve 150,000 acres in the valley below

GRAND VALLEY PROJECT, COLORADO

The preliminary plans have been made for the beginning of construction of a project in Grand Valley to irrigate 53,000 acres, of which 35,000 acres are public. It is expected that two years will be required to complete the works. The irrigable area in the project, in the opinion of horticultural experts, includes some of the finest fruit land in the country. The engineering works proposed include a diversion dam of masonry, with a movable crest; maximum height, 13 feet, and 450 in length; 71 miles of canals and 12,000 feet of tunnels.

FOUR PROSPEROUS TOWNS CREATED IN IDAHO

In the spring of 1904 I camped for the night on the banks of Snake River, Idaho. My companion, the engineer, confided to me his plans for a great work in this section which was to create in the desert a garden covering 25 square miles. He drew his plans roughly in the sand as we sat by the camp-fire.

"Here," he said, "I shall build a dam to turn the waters into huge canals on either side." When I returned another year the dam was finished. Pointing to a landscape of desolation, whose outer ends touched the sky, and on which there was no sign of human habitation, he said: "This desert will one day become a show place—a garden rich and productive, and supporting in comfort a thousand families."

Last year, standing where I did three years before, I realized that the engineer's dream had come true. Look where I would in any direction, I saw no desert. Cultivated fields, with harvests ready for garnering; pleasant little homes on each 40 and 80 acres; children playing in the sunshine, sturdy and happy; the garden crops being gathered for winter storage, gave abundant evidence that the soil was productive and, when watered, gave generous rewards to the farmer.

Twenty-two hundred families are living here today, when only a short time ago there was no sign of human life. Four prosperous towns, soon to become cities, have sprung up along the new railroad. This is a transformation to make you rub your eyes with wonder and amazement.

IN STRAWBERRY VALLEY, UTAH

Bringing water, which now flows into the Gulf of California, into Utah's great interior basin, from which no streams reach the sea, is an engineering work which is engaging the attention of the Government.

In a camp situated near the snowy summit of the Wasatch range a large force of men is driving a tunnel four miles long through the mountains, which will bring a tributary of the Colorado River into the Salt Lake Valley. A diversion dam in the stream below now diverts the water into a canal for several miles to a point where a power plant has been erected. The water is dropped through a pressure pipe upon the turbines, and the power generated is transmitted to that camp, now almost buried in the snow, where it is utilized to excavate the tunnel.

Far below a beautiful, sunny valley awaits the completion of the work. It lies at the foot of a lordly range of snow-capped mountains, and, with the present irrigation systems, is one of the richest agricultural districts of the State. Its crops are varied, and many are high-priced. Peaches and apples do exceptionally well here, the fruit being finely flavored and highly colored.

UMATILLA PROJECT, OREGON

On the banks of the Columbia River and in the valleys of its numerous tributaries in Washington and Oregon, there has been a phenomenal development of irrigation in the past four years. It is only a marker for what is due to follow in the coming years. Here is our true Inland Empire, a region vast in extent, drained by the noblest river in the West, with soil of great depth and fertility and a climate unsurpassed for the growing of fruits of unrivaled color and flavor, for vegetables of all kinds, and for the cereals and forage crops of the north temperate zone. In parts of this region

the growing season is as long as that of many favored valleys in California.

Located on the south bank of the Columbia River, in Oregon, and extending up the valley of the Umatilla River, the Service has partially completed the Umatilla project, embracing 20,000 acres of land having an average elevation of 470 feet above sea-level. In the beginning of the work, in 1906, this region was largely a sage-brush desert, unattractive and uninviting.

On the occasion of my first visit there, before construction had begun, one could drive for miles and never see a habitation. Where the thriving young city of Hermiston now stands, with its solid blocks of brick buildings, its fine schools and churches, and its charming bungalows, there were exactly three houses in sight. Today there are probably 700 people residing here.

An attractive feature about life in this community is due to the fact that the farms are small. Many homes have been esablished on five and ten acre farms which are located all about the town. Trees have been planted to shade the streets and lawns, and thousands of acres of orchards are being laid out.

The question of a municipal water supply is being agitated in Hermiston. Near the new city a tract of land embracing 40 acres has been reserved. It contains a spring which will furnish a water supply for a city of 50,000 inhabitants, and its water can be carried in pipes by gravity to any part of the town. A reservoir site has been found on the side of the high butte just outside of town into which the spring water can be readily pumped. This will insure a water system with sufficient pressure to furnish protection from fire.

While land values have increased rapidly, as the result of the Government's work here, the prices are not regarded as unreasonable when compared with other irrigated valleys in the Columbia Basin.

THE LARGEST PROJECT IS AT YAKIMA

The largest irrigation project of the Government is in Washington, on the eastern side of the Cascade Mountains, in the valley of the Yakima River. A number of beautiful lakes have been acquired by the Service and are being utilized as storage reservoirs to supplement the stream flow.

An interesting feature of the work here has been the construction of the Tieton canal, which for several miles hugs the edge of a precipice several hundred feet above the river. This is a cement-lined ditch, and the placing of the lining was a difficult task.

Cement forms made in the valley near the stream were carried up the steep canyon side on cableways, or by means of cars, and then set in place. More than two miles of the canal is in tunnel, and for several miles it winds around the edge of a perpendicular cliff.

In the Yakima River the Government has a concrete dam which diverts the water into the Sunnyside canal and irrigates today 45,000 acres, but which ultimately will supply 94,000.

The Yakima Valley is probably the best advertised agricultural district in the Northwest, and contains some of the most valuable agricultural and fruit lands in the world. It is today a region of small farms intensively cultivated.

The character of farm homes is as attractive here as can be found in any farming region in the world. In variety of crops it is not excelled by southern California, while in profitable yields it probably ranks with that favored section of the Southwest. A crop census of the lands irrigated by the Sunnyside canal in 1909 showed a gross average yield per acre of $70.

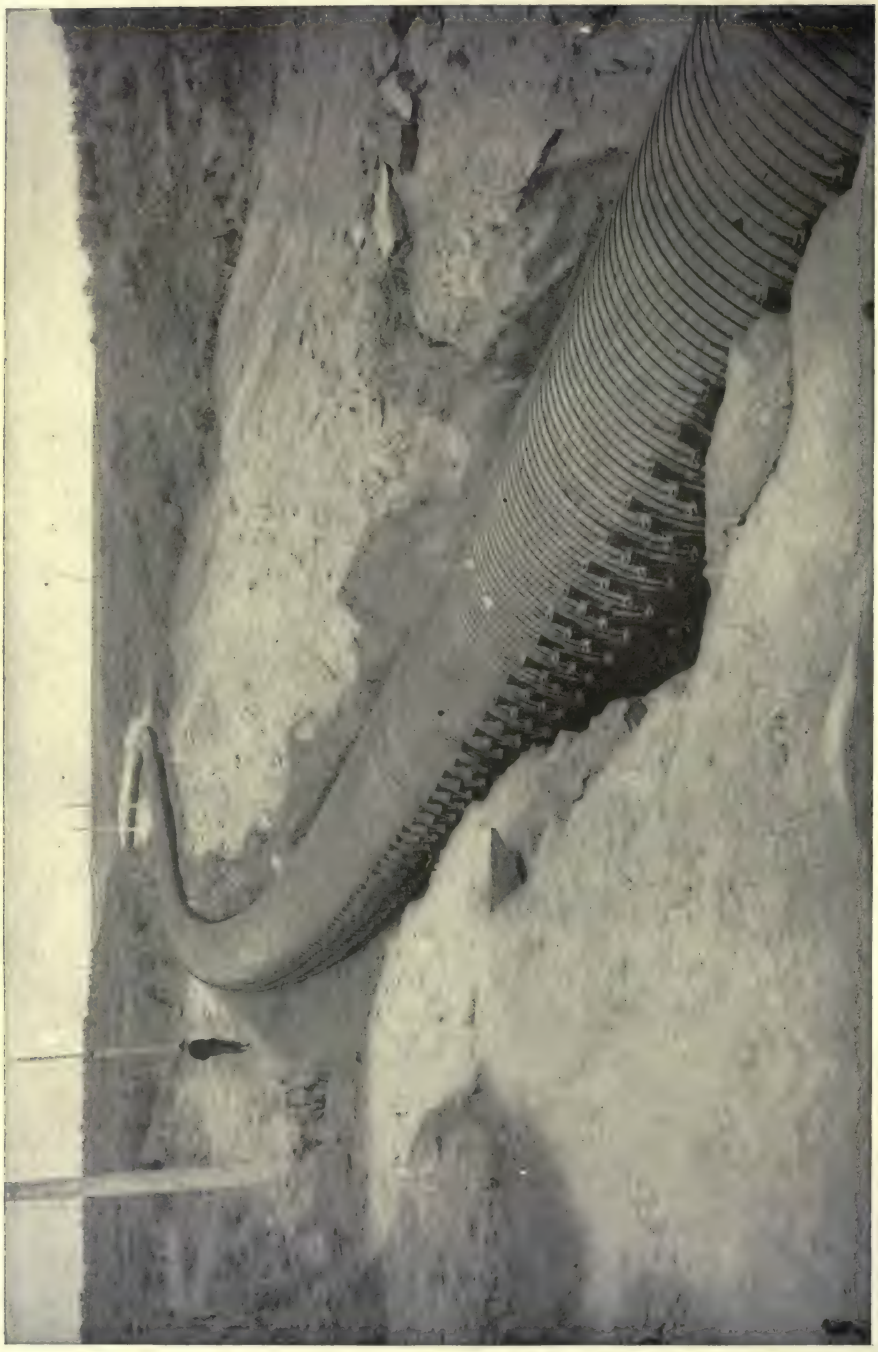
Some of the crop yields reported are difficult to credit.

Strawberries....	$150 to	$400 per acre
Cherries.....	150 to	350 per acre
Peaches.....	200 to	1,000 per acre
Apples.....	200 to	800 per acre

A strong organization of fruit-growers has been in existence here for a number of years, and as a result the fruit of the Yakima orchards finds a market today all over the world. We are glad to pay $1.50 per dozen in Washington now for

Photo and Copyright by Doubleday, Page & Co.

THE "FLATIRON BUILDING" COMPARED TO THE SHOSHONE DAM (SEE PAGE 346)



55-INCH WOOD-STAVE PIPE FOR CARRYING WATER ACROSS ROUGH COUNTRY: SUNNYSIDE UNIT, YAKIMA, WASHINGTON

Yakima Winesaps and Spitzenbergs, or about three times what we pay for oranges.

OKANOGAN PROJECT, WASHINGTON

One of the most interesting sections of the Northwest agriculturally is the Okanogan Valley, in northern Washington. While the project now being built in this valley by the Service is classed as one of the minor works, it is destined in the near future to add 10,000 acres of the most valuable land in the West to the cultivated area of the State. The orchards of this valley are among the most attractive in the world, and the fruit grown ranks with the best on the market.

For many years the valley has been so remote from transportation that its development has been slow. The Great Northern is now building a branch northward into it, and before this season's crops are gathered the Okanogan country will be in position to market its products in competition with the other celebrated fruit-growing districts of the Northwest.

TEN APPLICANTS FOR EACH FARM: THE YUMA PROJECT

The wonders of the delta of the Colorado River have been described so often that the public is now quite familiar with the valley of the American Nile. As proof of the public's interest in this region, nothing better can be mentioned than the recent opening of the first unit of the Yuma project, in California, on March 1, 1910. On that date 174 farms, averaging 40 acres each, were thrown open to entry, and there were approximately ten applicants for each farm. Successive units, to be opened as the work proceeds, are likely to prove as attractive as the first to homeseekers.

Just now the engineers are boring a tunnel under the river, in which it is proposed to lay a concrete-lined siphon 1,000 feet long, with an internal diameter of 14 feet. In this siphon a portion of the waters of the big canal on the California side will be passed under the river to the canal on the Arizona side. Considerable power will be developed at the outlet of the siphon, which will be utilized to lift water to the lands above the gravity system.

SALT RIVER PROJECT, ARIZONA

I shall never forget my first impression of the Salt River Valley. There was a whisper of spring in the soft and fragrant air that morning when I stepped from the Pullman car. After a dusty and tedious journey across the desert, the picture that greeted my eyes was that of another and a tropical land. In the early dawn the summits of the distant hills were glowing "like a Catherine pear the side that's next the sun."

In the grounds about the Capitol the vegetation was almost tropical in its luxuriance and variety. Here and there were wide avenues of magnificent palms, or shapely umbrella trees, with pleasant homes almost hidden by vines and flowers. Almond trees in blossom filled the air with fragrance. In succeeding visits to this sunny valley I have been impressed and fascinated with its future possibilities. The wide variety of crops which may be produced profitably here must attract agricultural experts from all parts of the country.

There is not a single day in the year when nature is not ready and willing to respond to the industry of the husbandman. The oranges are of superior quality and flavor. Dates yield abundantly, as also do figs, lemons, grape fruit, olives, and peaches.

Five to seven cuttings of alfalfa are grown, averaging seven to ten tons per acre.

OSTRICH FARMING IS VERY PROFITABLE

Ostrich farming is proving a very profitable industry, and nearly 8,000 birds are now owned in the valley. I am told each full-grown bird is good for $30 worth of feathers annually. An infinite variety of small fruits and vegetables, harvested early when the markets are best, make the truck industry a profitable one. For eight months in the year the climate here is unsurpassed.

The activities of the Government, which began in this valley almost immediately after the passage of the Reclamation law, have resulted in a large increase in population and in land values.

As an engineering task, the irrigation work laid out here by the engineers, and now nearing completion, is perhaps the most interesting as well as the most important yet undertaken. To provide an adequate water supply for 240,000 acres of land which, when irrigated, jump in value from nothing to $100 or more an acre is a task well worthy of consideration. This is especially true if an investment of $8,500,000 will accomplish it.

Difficult and trying indeed has been the task, owing to the physical conditions and the extremely erratic character of the river which furnishes the water. To understand the problem it is necessary to view the work on the ground.

The journey from Mesa, in the valley, to the scene of the big work covers a distance of 62 miles, 20 miles of which are across the desert. Here is a region quite unique in itself and differing materially from the deserts to the north. Its vegetation is more varied and interesting. The giant cactus here attains a great height and is often found in groves. A hundred species of thorny plants grow here.

At the end of the road across the desert we come upon a range of mountains whose pinnacled peaks rise straight up from the plain. Here our road leaves the desert and we enter a region rugged, upended, with rocks painted in wonderful colors.

The Government has carved this highway for many miles from the walls of rock. It is an inspiring trip, which would be terrifying but for the fact the road is broad and the grades are gentle.

At the end of our journey we stand on the brink of the wonderful gorge Salt River has cut through the mountains. Far below us the stream winds its way in a deep and shadowy canyon. Across the entrance to that gash in the sandstone cliffs the engineers have thrust a massive dam of rock and cement, which for all time will check the floods of the turbulent stream.

THE ROOSEVELT DAM

The Roosevelt dam, which is about completed as you read the story today, is in many respects the most remarkable structure of its kind in the world. Its towering height, 280 feet, its length on top, 1,080 feet, the inspiring scenery in which it is located, and the enormous capacity of the reservoir created by it combine to make it one of the most stupendous engineering works of modern times.

Conceive, if you can, two valleys—one 12 miles, the other 15 miles in length, and each from one to three miles wide—transformed into a lake 200 feet deep in places, and containing enough water to cover Delaware a foot deep.

The Salt River reservoir, when full, has a capacity sufficient to fill a canal 300 feet wide and 19 feet deep extending from Chicago to San Francisco. It would submerge the entire city of Chicago, which embraces 190 square miles, a depth of 11½ feet.

My one regret is that the space allotted me is too little to permit me to describe the charms and advantages of other projects of the Government. I should like to tell you of the opportunities on the Klamath project, located in southern Oregon, in a region of unrivaled scenic beauty; of the wonderful progress made in the Boise Valley, in Idaho, and the promise of even greater advance as the work of the Government nears completion; of the Orland project, in the Sacramento Valley, the land of fruits and flowers; of the Rio Grande Valley, where there will one day be erected the most stupendous dam in the West—a region in which irrigation began before the Spanish invasion, which will become fruitful and prosperous.

The beacon of hope shines brightly in the West. It beckons the landless man to the manless land.

ARTESIAN WATER PREDICTIONS

THE extensive investigations of underground waters carried on by the U. S. Geological Survey have afforded a basis for predicting artesian flows in several areas, and some of the predictions have been verified in the most gratifying manner. One of the most notable of these is a well at Edgemont, South Dakota, recently sunk by the Burlington Railroad Company. This company applied to the Survey for information as to prospects, and the matter was referred to one of the Survey geologists, Mr N. H. Darton, who had made a detailed investigation of the region. He predicted that water should be expected in the Deadwood sandstone about 3,000 feet below the surface.

Accordingly the boring was begun, but, meeting with many difficulties which caused great delay and expense, there was at times a disposition to abandon the work. The engineers in charge, having confidence in Mr Darton's prediction, urged a continuance of the boring, and their faith was finally rewarded by striking a great flow of water at a depth of 2,695 feet. The well yields a half million gallons a day of tepid water satisfactory for locomotive and other uses, and, as there is no good water within 60 miles and much of the supply had to be hauled in tank cars, the value of this flow is inestimable.

This artesian well, at Edgemont, South Dakota, is a practical illustration of the value of the scientific work of the U. S. Geological Survey (see text below).

Several other notable illustrations of artesian predictions are presented along the extensions of the Chicago, Milwaukee and Saint Paul Railroad and the Chicago and Northwestern Railroad, which have recently been built across western South Dakota from the Missouri River to the Black Hills. That country has but little surface water and mostly of poor quality, so that the problem of water supply was of vast importance. A careful investigation was made of the water-bearing strata which pass underground on the slopes of the Black Hills and furnish the supply for the flowing wells in eastern South Dakota. From the data obtained Mr Darton was able to determine not only the depth to the water-bearing sandstone, but the maximum height of land on which flows could be obtained. Eight wells, from 1,395 to 2,135 feet deep, have closely verified the predictions and furnished the requisite supply of excellent

ROYAL GORGE IN THE GRAND CANYON OF THE ARKANSAS BETWEEN PARKDALE AND CANYON CITY

The gorge is about 8 miles long and is a marvelous example of river erosion

water, not only for the railroads, but for several small towns.*

Similar investigations by Mr Darton of underground water conditions along the line of the Atchison, Topeka and Santa Fé Railroad in New Mexico, Arizona, and California have resulted in successful deep wells at Nelson, Picacho, Manila, Gallup, and Chaves. These are in an arid region where the hauling of water for engine use has been a large item in the operating expenses of the railroad.

It is difficult to estimate the money value of a successful artesian well in an arid region, but where it obviates the need of long haulage $50,000 to $100,000 is a moderate figure.

* Geology and Underground Waters of South Dakota, by N. H. Darton. U. S. Geological Survey. Water Supply Paper 227. Washington, 1909.

ASCENDING MONT BLANC, THE HIGHEST MOUNTAIN OF EUROPE

The summit, shrouded by a perpetual snowfield from which descend numerous glaciers, is ascended almost daily in summer. The illustration is from the new edition of "The Playground of Europe," by Leslie Stephen, recently printed by G. P. Putnam's Sons. This book, first published about 25 years ago, comprises 13 descriptive essays of the Swiss Alps. In beauty of expression and word pictures Mr Stephen excels, so that the volume is often called an English classic. Lovers of mountains will welcome the new edition with genuine pleasure.

A FARM-HOUSE IN THE BERNESE OBERLAND

Illustrations from "The Playground of Europe," by Leslie Stephen. G. P. Putnam's Sons

THE SUMMIT OF THE TITLIS

Peary alike felt that so much time had elapsed that adequate preparations could not be made for a satisfactory American Expedition.

The Board of Managers, on behalf of the Society, expresses its hearty appreciation to all members who have shown their interest in the proposed expedition by subscribing to the National Geographic Society fund. The subscriptions will be returned during the month of May. As several thousand remittances have to be made out, members will probably not receive them much before the end of the month.

ADDRESS FROM THEODORE ROOSEVELT

On March 14 the following cablegram was sent to Mr Theodore Roosevelt at Khartoum:

"*Theodore Roosevelt, Khartoum:*

"National Geographic Society sends congratulations on extraordinary success and immense scientific value of your expedition. We rejoice at continued health of you and all your party. We hope you

Secretary Smithsonian Institution.

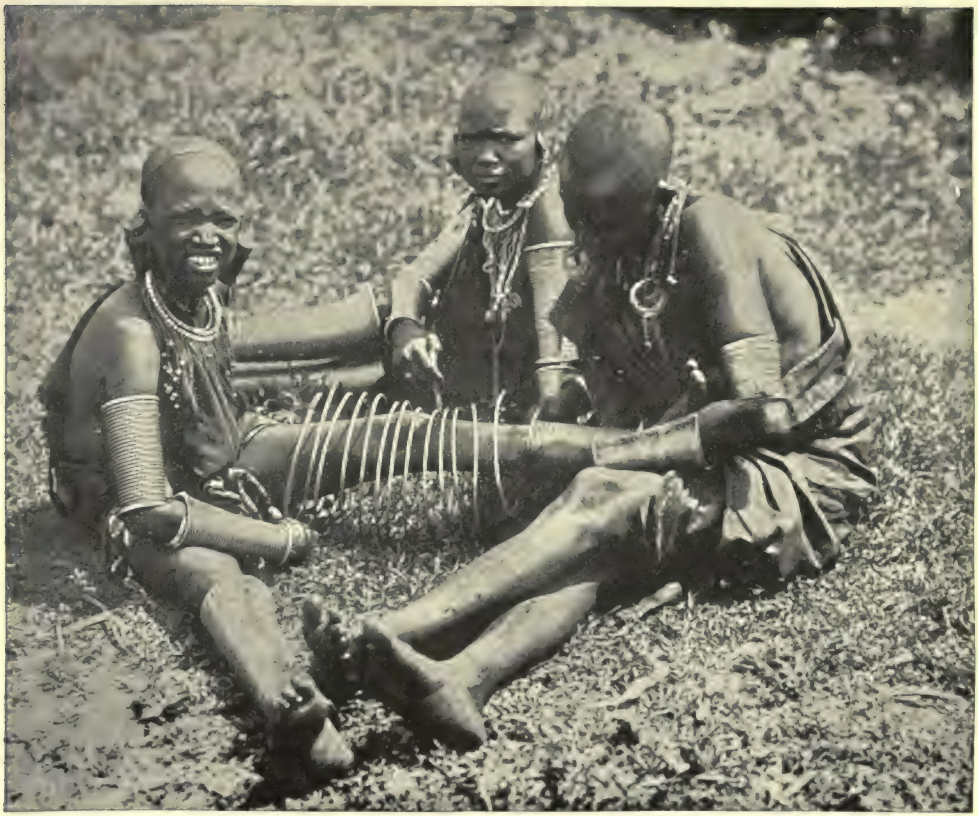
SIR: I have the honor to report that the Smithsonian African Expedition, which was intrusted to my charge, has now completed its work. Full reports will be made later by the three naturalists, Messrs Mearns, Heller, and Loring. I send this preliminary statement to summarize what has been done; the figures given are substantially accurate, but may have to be changed slightly in the final reports.

We landed at Mombasa on April 21, 1909, and reached Khartoum on March 14, 1910. On landing we were joined by Messrs R. J. Cuninghame and Leslie J. Tarlton; the former was with us throughout our entire trip, the latter until we left East Africa, and both worked as zealously and efficiently for the success of the expedition as any other members thereof.

We spent eight months in British East Africa. We collected carefully in various portions of the Athi and Kapitil plains, in the Sotik, and around Lake

Photo from Sir Harry Johnston

A FEMALE BABOON FROM THE SEMLIKI FOREST



YOUNG MASAI WOMEN COILING IRON WIRE AROUND THE LIMBS OF A FRIEND

This and the preceding four photos are from "The Uganda Protectorate," by Sir Harry Johnston

Naivasha. Messrs Mearns and Loring made a thorough biological survey of Mount Kenia, while the rest of the party skirted its western base, went to and up the Guaso Nyero, and later visited the Uasin Geisha region and both sides of the Rift Valley. Messrs Kermit Roosevelt and Tarlton went to the Lailsipia and Lake Harrington, and Doctor Mearns and Mr Kermit Roosevelt made separate trips to the coast region near Mombasa. On December 19 the expedition left East Africa, crossed Uganda, and went down the White Nile. North of Wadelai we crossed and spent over three weeks in the Lado, and from Gondokoro Mr Kermit Roosevelt and I again crossed into the Lado, spending eight or ten days in the neighborhood of Redjaf. At Gondokoro we were met by the steamer which the sirdar with great courtesy had put at our disposal; on the way to Khartoum we made collections at Lake No, and on the Bahr el Ghazal and Bar el Zeraf. We owe our warmest thanks for the generous courtesy shown us and the aid freely given us, not only by the sirdar, but by all the British officials in East Africa, Uganda, and the Sudan, and by the Belgian officials in the Lado; and this, of course, means that we are also indebted to the home governments of England and Belgium.

On the trip Mr Heller has prepared 1,020 specimens of mammals, the majority of large size; Mr Loring has prepared 3,163, and Doctor Mearns 714—a total of 4,897 mammals. Of birds, Doctor

Mearns has prepared nearly 3,100, Mr Loring 899, and Mr Heller about 50—a total of about 4,000 birds.

Of reptiles and batrachians, Messrs Mearns, Loring, and Heller collected about 2,000.

Of fishes, about 500 were collected. Doctor Mearns collected marine fishes near Mombasa, and fresh-water fishes elsewhere in British East Africa, and he and Cuninghame collected fishes in the White Nile.

This makes, in all, of vertebrates:

Mammals	4,897
Birds (about)	4,000
Reptiles and batrachians (about)	2,000
Fishes (about)	500
Total	11,397

The invertebrates were collected chiefly by Doctor Mearns, with some assistance from Messrs Cuninghame and Kermit Roosevelt.

A few marine shells were collected near Mombasa, and land and fresh-water shells throughout the regions visited, as well as crabs, beetles, millipeds, and other invertebrates.

Several thousand plants were collected throughout the regions visited by Doctor Mearns, who employed and trained for the work a M'nyumnezi named Makangarri, who soon learned how to make very good specimens, and turned out an excellent man in every way.

Anthropological materials were gathered by Doctor Mearns, with some assistance from others; a collection was contributed by Major Ross, an American in the government service at Nairobi.

I have the honor to be,

Very truly yours,

THEODORE ROOSEVELT.

THE NATIONAL GEOGRAPHIC SOCIETY'S ALASKAN EXPEDITION

The Board of Managers of the National Geographic Society has made an appropriation of $5,000 for an Alaskan Expedition in 1910 under the leadership of Prof. Lawrence Martin, of the University of Wisconsin. The work will be a continuation of the glacial studies carried on by Professors Tarr and Martin for the Society in 1909, and described briefly in the January number of the NATIONAL GEOGRAPHIC MAGAZINE, and more fully in a book now in preparation.

The expedition will leave for Alaska early in June, spending three or four months in field work among the glaciers of the Alaskan coast, where the most active advances of ice tongues that man has ever seen are in progress among the greatest existing glaciers outside the polar regions.

The work will begin with a brief visit to Yakutat Bay, where it is of the utmost importance to determine what glaciers, if any, have resumed activity since 1909, and what has happened to the glaciers which were then so active. Following this the glaciers of the lower Copper River will be examined in detail.

The Columbia Glacier will then be studied to see whether the great advance in progress in July and August, 1909, has continued, and after this the other glaciers of Prince William Sound will be visited and the larger phenomena of glaciation investigated.

The party will consist of a skilled topographer, loaned by the U. S. Geological Survey, a photographer, and several other assistants. The work will include not only studies of the ice, the glacial deposits, relations to life, etc., but precise mapping, observations of nature and rate of ice motion, sounding in the fiords near the fronts of the tidal glaciers, etc.

The present time seems to be one of unusual opportunity for study of these Alaskan glaciers, for scientists might have to wait decades or centuries for a repetition of the ice-flood advances now in progress. They have already revolutionized our theories of the cause for glacier advance. The new theory explains these oscillations of Alaskan glaciers, not by climatic fluctuations, but by avalanching during violent earthquakes. The advance of at least eight glaciers in Yakutat Bay, including part of the great Malaspina Glacier, about 300 square miles of which became crevassed in less than ten months, as well as the Hidden Glacier, which advanced two miles, and many others is thus understood.

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THE NATIONAL GEOGRAPHIC MAGAZINE

THE HOUSE-FLY

BY N. A. COBB

With photographs made specially for the National Geographic Magazine by N. A. Cobb

THE fly referred to in these pages is the one most commonly found in our houses—the *Musca domestica* of Linnæus. At most seasons nine flies out of ten found in houses are of this kind. In some of the paragraphs, however, the statements are inferences fully justified by experiments with very similar species.

Speaking broadly, man has made the house-fly; it has developed along with the human dwelling. If we had no closed-in dwelling places it is doubtful if the house-fly as at present constituted could continue to exist. It thrives simply because we afford it food, protection, and breeding places.

It is a comforting thought that just as we have made the house-fly, so we can unmake it, but it is discouraging to think how long it will take us at the present rate.

Following man into all but the coldest climates, this fly is found in nearly all parts of the world, and its name in many languages denotes the fact that it is an indoor or household insect. In the past it has been looked upon with indifference, or, at most, struck at with objurgation when too familiar. It figures in fable and poetry, not without some degree of praise occasionally. Its reputation as a harmless, innocent, lively, and interesting creature will die hard.

In reality it is one of our worst enemies. Its relations to human health and sanitation are most important, and yet for years all efforts to bring the facts properly to the attention of municipal authorities met with indifference or ridicule. We had become so accustomed to put up with the losses of life and property directly traceable to flies that we no longer had the capacity to grasp the significance of very simple facts—facts demonstrable by almost any one at the expense of a few minutes, or at most a few hours, of observation or experiment. Again, it was so easy to turn the whole matter into what passed for a joke that the gravity of the subject was lost sight of.

Latterly, however, a gratifying change is taking place in public opinion, due no doubt to what has been discovered about mosquitoes. It has been shown that these latter insects are one of the main factors in the production of diseases that frequently have claimed their victims by hundreds, or even thousands, under most

tragic circumstances. No mosquitoes, no malaria. No mosquitoes, no yellow fever.

In sanitary matters the tragedy that appeals to us strongly enough to make us do something worth while must be a tragedy quick in its action and very awful in its results. One is almost tempted to say that if only a disease is insiduous enough it may proceed without opposition, even though we know all about its cause and the means for its prevention. How otherwise can we explain the prevalence of consumption? One hundred yellow-fever victims per week move us more than the regular mortality from consumption that same week, though the latter may be a hundred times the greater.

If consumption laid hold of its victims suddenly and took them off in a few days, what a difference it would make in our attitude toward it! And yet it does far worse. It lingers and tortures its victim, often for years, making life a burden to him and to his friends, a continual source of care and expense, a continual source of sorrow, and, worst of all, a continual menace to all who come in contact with him or his belongings. It does worse, while we too often continue to tread the old beaten track, more or less apathetic, failing to do what we know we ought to do.

However interesting and horrible this psychological aspect of consumption may be, I wish at the present time to do no more than make it illustrate the attitude we have assumed toward flies, which is hardly less interesting and deplorable.

But people are beginning to ask, if the mosquito is so important a factor in human diseases, whether the people who for a generation or more have been calling attention to the house-fly as a distributor of disease may not have a case worthy of attention. The result has been a slow and partial awakening, so that we now have municipalities with sufficient enlightenment and courage to begin the fight against flies. I say courage very advisedly, because it takes courage of an uncommon sort, in matters of this kind, to act up to convictions we know are not shared by the majority of our neighbors. Fighting public indifference is a thankless task, especially when it is accompanied by an undercurrent of half-conscious guilt.

We have been slow to recognize the important part insects play in the spread of disease, because it is difficult to catch them in the act. The insects themselves are small and elusive, and the disease germs even more so. It is a rare occurrence for us to know at what time, or precisely in what manner, we have become infected with the germs of disease. It is almost always a matter of guesswork. If, therefore, any one is skeptical about the dangerousness of flies, and asks to be shown a case in which it can be proved that flies have infected a human being, he sets a difficult task. There is no difficulty whatever in causing flies to come into contact with virulent germs, nor is there any difficulty in showing that they can transfer these germs to healthy animals, and that the animals in consequence become diseased. This has been done and constitutes one of the main proofs of the dangerousness of flies.

There is plenty of evidence that flies, having come into contact with diseased material, have afterwards by their contact with persons or their food *probably* caused the disease that followed. This, however, does not constitute that rigid and satisfactory proof we would prefer. Nevertheless, such histories can now be assembled in numbers that amount to the strongest kind of circumstantial evidence. There are a number of diseases whose annual increase and decrease harmonize with the abundance of flies in precisely the way they would do if flies were the inoculating agency. The circumstances fully warrant us in accusing the fly of transferring almost any infectious disease that occurs in fly-time.

The fly's power to spread disease is a direct function of its powers of locomotion. It can fly considerable distances at a high rate of speed. It is quickly carried long distances by trains, boats, teams, animals, and man.

It is possible to get a good idea of a fly's rate of flight in a number of ways.

Flies come to ships newly arrived in port across considerable stretches of water. This we know, because a few hours earlier there were no flies on the ship. No communication has been had with land. The flies must have come on their own wings. Occasionally we see a fly follow a team or animal, easily keeping up a good pace. The wing muscles of a fly when weighed are found heavier in proportion than those of any bird so far examined. It is difficult to tire a fly out. Test this by trying to keep one constantly on the wing in a room and you will soon find you have no easy task. All this shows the fly to be no mean navigator of the air.

If such an active and adventurous insect as the fly carries disease germs it will quickly spread them far and wide.

Most of our diseases are caused by invisible germs that lodge and grow in our bodies, destroying our tissues or poisoning us with their excreta. These germs may be brought to us from some sick person by whatever is large enough to carry them and has the opportunity. Combine this fact with what every one knows about flies, and we see at once the tremendous importance of flies as carriers of human disease germs.

The result of this simple piece of reasoning is so startling that it is often sidetracked by its own importance. It looks so incredible that we hesitate, distrusting our own logic. It seems incredible that men have gone on doing as they have done, and as they are still doing, if the facts are as they seem. The consequences of our reasoning seem so tremendous we fear there must have been a mistake somewhere. And so we dismiss the idea.

One way to disturb this false security is to interest people in the habits and structure of flies. The more we know about flies the more clear it will become that they are among our worst enemies.

The photographs illustrating this article have been designed with this end in view. Take for instance the view of the fly resting on glass and viewed from below. Look at the feet, and observe that each of them has two claws and two light-colored pads. The fly clings to rough surfaces by means of the claws, and to smooth surfaces by a combined action of the claws and pads. The fly's pads are covered with thousands of minute short hairs, sticky at the end. There is no suction—merely adhesion.

The action of a fly's pads may be illustrated by means of a piece of sticking plaster and a few threads and small weights. Take a piece of sticking plaster half an inch wide and sew through it some short pieces of thread at intervals of half an inch, and knot the threads on the sticky side so that they cannot pull through. Stick the plaster to a dinner plate or other smooth object and it will be found that if a small weight is attached to each thread the plaster will sustain in this way a considerable weight—that is to say, the sum of all the small weights is considerable.

Now, remove the weights and attach all of them to one or two of the threads at one end. The plaster will promptly be torn loose. Acting on a portion of the plaster at a time, the weights can accomplish what they cannot accomplish when distributed along the whole surface of the plaster.

This experiment illustrates roughly how the fly uses and controls its feet. Of course, in my illustration you can see just how the weights release the plaster from end to end. It is very difficult to make this observation on a fly, because the fly's pad is so small, and more particularly because the whole operation takes place in something like the fiftieth part of a second.

Wonderful as the fly's pads are, they have their disadvantages, for stickiness and locomotion are not always strictly compatible. Humorous use is made of this idea in Uncle Remus tales, "The Tar Baby" and "The Outrageous Prank of Brer Rabbit." In one of these Brer Rabbit takes advantage of the stickiness, not only of his feet, but the rest of his anatomy, to strike terror into the souls of the other animals. Raiding Brer Bar's pantry, he accidentally breaks the

Photo by N. A. Cobb

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FEMALE HOUSE-FLY RESTING ON GLASS AND SEEN FROM ABOVE

The house-fly swallows many kinds of germs and spores, and deposits them all day long at intervals of a few minutes in its excreta, the "fly specks." These germs and spores pass through the fly in less than an hour, and come out in the fly specks alive and uninjured. Flies spread more germs in this way than in any other. The house-fly sticks close to man and is a dangerous agent in the spread of human diseases. Diseases of animals and plants are spread in the same way. The hairs on the back of a fly are not a haphazard arrangement, but correspond in number and location on all house-flies.

Photo by N. A. Cobb

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MALE HOUSE-FLY RESTING ON GLASS AND SEEN FROM BELOW

In addition to two claws, each of the six feet is supplied with two light colored sticky pads. Germs and spores stick to these pads, and are thus carried from place to place with great rapidity, for the fly travels fast and far on its own wings, and on cars, boats, and other moving things. The fly cleans its feet carefully whenever they become contaminated, thus removing many of the germs that would otherwise be spread, but not all.

Photo by N. A. Cobb

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FRONT VIEW OF THE HEAD OF A HOUSE-FLY

The same head is shown in profile on the opposite page. The fly is one of the most highly organized of insects. The two large areas studded with thousands of facets are the compound eyes. The three simple eyes are seen at the top of the head in the middle. See also top view of the fly. The two large pendant organs with "peacock feathers" on them are the antennæ, or "feelers." A fly can see in all angular directions.

Photo by N. A. Cobb Copyright, 1910, by the National Geographic Magazine

SIDE VIEW OF THE HEAD OF A HOUSE-FLY

The same head is shown front view on the opposite page. The end of the proboscis carries a sieve through which all the food is strained. The meshes of this sieve allow germs and all but the largest spores to pass. The house-fly takes in only liquid food. When the fly eats solid food, it first spues saliva on it so as to dissolve it.

honey jar over himself to such a tune that, as Uncle Remus says, "He wan't jes' bedobble wid it, he was jes' kivered." Brer Rabbit soon discovered that this condition was incompatible with convenient locomotion. Things stuck to his feet in such an unusual way as to suggest to this practical joker what a spectacle he would present if he should roll himself among the sticks and leaves in Brer Bar's yard. Carrying out this idea, Brer Rabbit presents himself to the other animals with the usual side-splitting results.

In the "Tar Baby"—"One day Brer Fox rig up a contraption what he call a tar baby." This sticky puppet placed cunningly in Brer Rabbit's path excites Brer Rabbit's ire, because he "won't say nuffin" in response to Brer Rabbit's overtures. In his efforts to teach him manners Brer Rabbit hits the tar baby, and as the tar baby will not let go, and still persists in "sayin' nuffin," Brer Rabbit hits him with the other hand. This is the beginning of such a tangle between Brer Rabbit and the sticky tar baby that Brer Rabbit is completely entrapped and falls into the hands of Brer Fox.

All his grown-up life the fly has to manage with sticky feet. Imagine our plight if the soles of our feet were sticking plaster, perennially renewing its stickiness! Whoever has experienced the sticky mud of certain regions will recall how the boots ball up and what a conglomeration one drags home from a ramble under such circumstances.

To such inconveniences the fly is constantly subject, and it is this that has bred into him a habit of frequently preening himself, particularly his feet. These are constantly becoming clogged with adhering substances, and this contamination the fly must assiduously remove if his feet are to act properly in supporting him on slippery places. If this contamination is too sticky to rub off the fly laps it off, and it then passes off in his excreta.

Thus it is that all sorts of microscopic particles are moved from place to place on the feet of flies. These particles are rarely of sufficient size to be seen with the unaided eye. Nevertheless, they are constantly present, and the amount of matter thus transferred is relatively considerable on account of the fly's activity. When flies have access to diseased or rotten or foul matter the transfers thus effected are dangerous. All sorts of minute organisms are spread in this way, including diseases of man, animals, and plants. It is impossible to go into details in this place, but it is only right to say that the imagination completely fails to grasp the far-reaching consequences of this transfer of germs and spores on the feet of flies.

Unfortunately, this is not the worst of it. The transfer of germs by means of the fly's feet is a small matter beside that which takes place through its excreta.

The following is the defecation record of a well-fed fly (the fly was fed at 9:23 a. m.):

Interval times		*Notes on spores in the excreta*
....	9.35....	
8....	9.43....	
6....	9.49....	Spores in excreta seen to pass.
3....	9.52....	
6....	9.58....	
1....	9.59....	Spores.
2....	10.01....	Spores.
4....	10.05....	
5....	10.10....	
3....	10.13....	
3....	10.16....	
4....	10.20....	
3....	10.23....	
3....	10.26....	Spores.
2....	10.28....	Found one.
1....	10.29....	
1....	10.30....	Spores.
13....	10.43....	Very many spores.
1....	10.44....	
3....	10.47....	Found one.
15....	11.02....	Very many spores.
9....	11.11....	
9....	11.20....	Very many spores.
6....	11.26....	

The time lapsing between the movements varied from 1 to 15 minutes and averaged about 4½ minutes.

No wonder that fly specks are common if the fly evacuates once in five minutes all day long! The number of specks in even the best-kept houses is simply appalling. I might be accused of sensationalism if I should publish records in

my possession gained through the use of a little counter which can be used to estimate the number of fly specks on a given area.

We men-folks are much less observant in this matter than our better halves, but even a man, after a short period of training, finds no difficulty in astonishing himself at the abundance of fly specks in situations that show them off to advantage; for instance, on ordinary window panes. No housewife needs to be told that one of the main reasons for cleaning windows is the presence of fly dirt, but even she will, I think, be surprised at the results of actual counts. The fact is we ordinarily notice only the largest and the darkest. The great majority escape notice because they are small or transparent and colorless. Window panes with from 1,000 to 10,000 fly specks per square foot are not at all uncommon. From 10 to 50 per square foot is a common number in what are considered well-kept homes. Spotless glass is rare, except on house-cleaning day.

This is in situations where the dirt can be readily seen. On neutral tinted objects, less often cleaned, fly specks occur in millions. On wall-paper, chandeliers, outside veranda posts, on cornices, ceilings, and window blinds the numbers are almost past computation.

The amount of this fæcal matter deposited by flies is of course in proportion to the number of flies. When the flies have access to diseased or rotten or foul matter these fæces are dangerous. If there is any infectious or contagious disease in your neighborhood in fly-time, beware of flies!

Flies swallow the germs of typhoid in countless millions while feeding on the excreta of typhoid patients. As a result they spread a thousand times more typhoid germs in their excreta than on their feet. My own experiments have shown that the spores of a variety of diseases pass through various species of flies without appreciable change, and that without doubt certain diseases produce odors that entice flies to swallow the spores so that these latter may be more efficiently spread abroad. The germs are just as virulent after passing through the fly as before.

My experiments show that the greatest variety of spores and microbes can, and normally do, pass through flies and germinate afterwards. In fact, the most delicate spores are little if any injured by the fly's digestion. Among those tried are the spores of some of our commonest and most destructive moulds and spores of nearly all the diseases of sugar-cane and those of numerous other plants. In short, it rarely happens that spores of any kind swallowed by a well-fed fly do not appear in an hour or so in the fæces of the fly in an uninjured condition, such that they germinate readily afterward. Finally, as might be expected, examination of the excretus of flies captured in the open shows it to contain a great variety of spores in a living condition.

I find the digestion of the adult fly to consist in the absorption of those substances readily soluble in its weak digestive fluids and the evacuation of all others. In accordance with this principle the fly is an enormous feeder. At a single meal it frequently swallows nearly half its own weight of food. In the course of a day a well-fed fly probably as a rule swallows more than its own weight of food.

During the summer the fly population of any large town must number millions. Comparing this fact with the food habits of the fly, we see at once the importance of the rôle they play in our affairs, more particularly in view of their disease-carrying powers. I venture to think the most powerful imagination fails to take in the vast multitude of conclusions that follow from these simple lines of reasoning.

What has been said is an attempt to show that the house-fly is a character of much greater significance to us than is indicated by his adornment of a fable. He really does have something to do with the turning of the wheel, but it is the wheel of life. He may have little to do with keeping it going, but he certainly sometimes has much to do with stopping it.

The fly does far worse things than get into the ointment, for unless we take care he gets into or onto pretty much everything we eat or drink. Such an occurrence is not simply disgusting; it is more or less dangerous, and the danger lies in the introduction into our bodies of disease germs. This danger is far more real than commonly supposed. There can be no doubt that much sickness is started in this way.

The question is, What ought we to do about it? The answer is simple, and it is that we ought to take greater precautions, both individually and collectively—

First. To fully inform ourselves on this subject by reading and observation.

Second. To prevent the multiplication of flies. Abolish their breeding places. Protect food and refuse so that flies cannot get at them.

Third. To keep flies out of our buildings and streets.

Fourth. To employ all reasonable agencies to destroy flies that come into existence in spite of our other precautions.*

*For further information on the ravages caused by flies see "Economic Loss to the People of the United States through Insects that Carry Disease," by Dr L. O. Howard, August, 1909, NATIONAL GEOGRAPHIC MAGAZINE, pp. 735-749.

NOTES ON THE DISTANCES FLIES CAN TRAVEL*

By N. A. Cobb

IT is very difficult to make the necessary direct observations as to the distances flies can travel and their rate of speed—flies' motions are so rapid. Nevertheless, in the course of time I have been fortunate enough to witness a number of convincing instances. To these I have added the indirect evidence of comparative anatomy. If the fly's wing muscles are unusually bulky, it is a fair inference that its flight will be quick, or long sustained, or both.

I have never succeeded in tiring my flies very perceptibly if they had a free space to move about in. When confined in a room they may be kept on the wing for hours without showing many signs of fatigue. Though they move twenty feet to the experimenter's one, they will often succeed in tiring him out if he undertakes the task of keeping them always on the wing. The instance of the fly starting to cross the Mediterranean Sea is a very striking one. (See page 382.)

EXPERIMENTS INDICATING THE GREAT POWERS OF FLIGHT POSSESSED BY SOME FLIES

Among insects, as among birds, fliers of two very different types are to be found—those that soar and those that fly. Without entering deeply into the question, this division may be said to be about as marked among insects as among birds. The fliers among insects, to which class the flies belong, correspond, however, more nearly to the extreme limit reached in humming birds.

The rate of wing vibration in flying insects is higher than any wing rate among birds. In fact, the difference is so great that it raises altogether new mechanical and physiological questions. In the case of insects these questions have excited the interest and attention of minds of the highest order, as is apparent on looking over the literature of the question.

The flies belong to the quick-action group of flying insects, the principles of

*Abstracted from "Fungus Maladies of the Sugar Cane," by N. A. Cobb

whose wing musculature appears to have been first explained correctly by Graber. No one has yet, however, fully explained how it is that these insects are able to execute such quick movements. Is it possible that the division of the thoracic muscles into groups, a division that seems to prevail in all the insects that fly in this manner, is a provision by which the muscles act in relays? If we recall the motions that are executed by a single pair of antagonistic muscles, can we recall a single instance where movements are executed at the rate of several hundred per second? I doubt if even in those minute forms where there appears to be the least molecular difficulty—I refer to the cilia of microbes—so high a rate of vibration would be claimed. (I know of no investigations.) Few men can execute more than ten movements per second with any muscle.

It has often struck me when examining the batteries of muscle by which the quick-action insects execute their wing movements, that here is a mechanical and physiological problem that it would be well worth while to investigate.

ENORMOUSLY POWERFUL WING MUSCLES OF FLIES

Ten flies of the smaller of the two sarcophagous species found common at this Station* were weighed after being chloroformed. They were taken as captured in the middle of the day. No doubt a slight amount of the vapor of chloroform added to the apparent weight of these ten flies, which was 478 milligrams. The central thoracic muscles were removed and weighed, and also the two sets of lateral muscles. The result was 67.5 milligrams for the central and 58.5 for the lateral. Thus we have:

Average weight of fly, 47.83 mg.

Average weight of lateral batteries of muscle, 5.85 mg.

Average weight of central battery of muscle, 6.75 mg.

Total weight of muscles, 12.6 mg.

From which we learn that the weight of the central thoracic muscles is 14.1 per cent of the weight of the fly, and the weight of the lateral thoracic muscles is 12.2 per cent of the weight of the fly, and that together these thoracic muscles constitute 26.2 per cent of the weight of the fly.

The method was to fix the flies in 50 per cent alcohol, dissect out the muscles, soak them in water for several hours, remove the excess of water and weigh the muscles barely moist.

Eight females of the commonest species of *Syrphus* about the Station had their great thoracic muscles removed and weighed, with the following results:

Longitudinal muscles, 12.3 per cent of the weight of the fly.

Oblique muscles, 9.2 per cent of the weight of the fly.

Total, 21.5 per cent of the weight of the fly.

A similar trial with ten males weighing 774 mg. gave as a result:

Longitudinal muscles, 17.12 per cent of the weight of the fly.

Transverse muscles, 12.5 per cent of the weight of the fly.

Total, 29.62 per cent of the weight of the fly.

The males of this species have a greater proportion of muscle than the females. This appears to be generally true of flies.

The wing muscles of a notable flier, *Volucella obesa*, often to be seen, especially in the morning, standing in the air in shady places in Honolulu, were removed and weighed in the same manner as described for the two sarcophagous species. The result showed that the longitudinal muscles constitutes 25.7 per cent of the entire weight, while the oblique sets constitute 22.3 per cent of the entire weight, so that together these muscles constitute no less than 48 per cent of the weight of the insect. It should be noted that all the specimens examined appeared to be males, and the absence of gravid females may in some degree account for the difference between these results and those noted in the case of the sarcophagous flies. How-

*Experiment Station of Hawaiian Sugar Planter's Association, Honolulu.

ever, it could not account for more than a portion of the great difference.

This result is from the examination of ten specimens that in the aggregate weighed 674 milligrams.

WING RATES OF POWERFUL INSECT FLIERS

Records of wing vibrations of a specimen of *Syrphus* that had been in captivity 24 hours, and meanwhile fed on sugar and water, gave, as the average of four tests, 400 per second. The voice of this fly when scared by pressure varied from violin A to the C above.

A second specimen gave 378 as the average of five tests. One test in the same quarter-second gave 341 and 578, the slower being at the beginning of an effort, the faster at the maximum speed attained. These rates, which at first appeared to be the true wing rates, proved ultimately to be subsidiary vibrations.

Wing vibrations of *Volucella*, 298, average of six tests. The tests varied remarkably, being as follows: 228, 253, 275, 282, 348, 405. The latter two are remarkably above the others, and are subsidiary vibrations.

Three tests on a green-bottle fly gave 250, 258, 196. Average, 235.

A large sarcophagous fly, female, as the result of seven tests, gave an average of 246 per second. In the course of these tests rates as high as 400 were observed for short periods of time, but these were probably subsidiary vibrations. The tests ran as follows: 199, 206, 227, 257, 268, 281, 281.

The wing vibrations of one of the large sarcophagous flies held captive, on being chronographed, gave as the result of seven different trials 203 vibrations per second.

Golden dragon fly (*Pantala flavescens*, Fab.), 17 per second, five observations, one individual.

Large dragon fly (*Arax junius*, Drury), 22 per second, seven observations, one individual.

Tuning-fork tests on the same paper as the above tests gave results as follows: Pitch, A international. 420, 446, 462. Average, 443.

HIGH WING-RATE FLIERS VS. THE SAILERS

The dragon flies are well known to be powerful fliers. Nearly everybody must have noticed the bold flight of these conspicuous insects, which may at times be seen soaring high above the roofs of houses in our towns, and even over the tops of some of our high hills and mountains. We may, therefore, arrive at a more accurate conception of the flight of flies if we compare it with that of these larger insects which come under more common observation.

The relative powers of flight of the fly *Volucella obesa* and the large dragon fly is shown by the usually futile attempts of the latter to capture the former. I have never seen a *Volucella* captured by one of these dragon flies, though the *Volucella* when standing still in the air offers an unusually fair mark. When the dragon fly arrives the *Volucella* is gone. The fact that dragon flies continue to make passes at them may indicate that the flies are sometimes caught.

A golden dragon fly and a *Volucella*, whose weight were to each other as 297.4 to 64.2 (mg.), had wing areas that were to each other as 46.8 to 1.6.

Or, to speak approximately, a dragon fly weighing only four to five times as much as a fly, both being expert fliers of their respective kinds, had a wing area thirty times as great.

A *Volucella* fly and a large dragon fly, whose weights were to each other as 64.2 to 1598.5 (mg.), had wing areas that were to each other as 1.6 to 82.; that is to say, speaking approximately, the dragon fly, while she weighed only 25 times as much, had a wing area over 50 times as great.

A REMARKABLE FLIGHT

I remember once to have witnessed a very remarkable example of the power of flight of one of the larger flies. On a voyage across the Mediterranean from Algiers to Marseilles in company with Prof. W. T. Swingle, I observed a dipterous insect keeping pace with the steamer so accurately that it almost seemed as if it were joined to the boat

by some invisible rigid connection. The boat left Algiers at noon, and as long as there was any light left by which to observe, the insect kept its place steadily. This was in midsummer. The insect never made any attempt to come aboard.

The boat was not particularly fast, her speed being, so far as I could judge, about thirteen knots. When we consider that the insect was all the time supporting itself in the air while the boat merely floated on the water, and thus had its weight supported, the comparison between the two is all the more striking.

FIGHT THE FLIES

We reprint herewith a circular recently published by the American Civic Association, which is conducting a vigorous campaign against the fly

IT is at this time of the year that the house-fly begins to take on life for the ensuing spring and summer; eggs laid last fall will soon begin to hatch. At first he is only a little worm, wriggling his tiny grub-like form in some incubating pile of filth. He is usually found in the manure pile, the outhouse, or the mound of rubbish or garbage in the back yard. In this condition he is easily killed, and it should be the duty of every person to kill him now. The house-fly could not exist if everything were kept perfectly clean and sanitary. Exterminate the fly-worms, do away with its breeding places, and there will be no flies. If we are to fight the flies this summer we should use every agency possible, and the best way to fight them is to prevent their breeding.

The common house-fly is coming to be known as the "typhoid fly," and when the term becomes universal greater care will be exercised in protecting the house from his presence.

Flies kill a greater number of human beings than all the beasts of prey, with all of the poisonous serpents added. They spread disease which slays thousands, while big, powerful beasts kill single victims.

As soon as the fly comes out of his shell he is full grown and starts out in the world to make a living, and if your home is not clean he knows it by the odor. They can discern an odor of filth for miles.

As much as they like filth odors they dislike other odors. Where a bad odor will attract them the clean odor will repulse them. A pleasant-smelling substance—the fragrance of flowers, geraniums, mignonette, lavender, or any perfumery—will drive them away.

He is a frequenter of offal. The fly lays her eggs in the manure pile or other objectionable filth. All the germs—all the imaginable abominable microbes—fasten themselves on the spongy feet of the fly. He brings them into the house and wipes them off his feet. The fly you see walking over the food you are about to eat is covered with filth and germs. If there is any dirt in your house or about your premises, or those of your neighbors, he has just come from it. It is his home. Watch him as he stands on the lump of sugar industriously wiping his feet. He is wiping off the disease germs, rubbing them on the sugar that you are going to eat, leaving the poison for you to swallow.

He wipes his feet on the food that you eat, on the faces and on the lips of your sleeping children. This does more to spread typhoid fever and cholera infantum and other intestinal diseases than any other cause.

Disease attacks human beings only when they are brought in contact with it. For instance, you cannot get typhoid fever unless you swallow the germs of typhoid, and you do not swallow these

germs unless they get on the food you eat or in the liquids you drink, or on the glasses or cups from which you drink.

Not only does he scatter the seeds of disease from his body over your food, but before your fruit and vegetables are placed before you they have been subjected to his filthy habits, either in the kitchen or in the stores, where he flies from the horse dirt in the middle of the street to the tubercular sputum on the sidewalk, and then back to the foodstuffs displayed for sale.

Many diseases which are attributed to milk and water originate through flies. A polluted brook, river, or lake furnishes germs from sewers, and flies in millions settle on the refuse that washes along the water's edge.

Intestinal diseases are more frequent whenever and wherever flies are most abundant, and they and not the summer heat are the active agents in its spread.

There is special danger when flies drop into such fluid as milk. This forms an ideal culture material for the bacillus. A few germs washed from the body of one fly may develop into millions within a few hours, and the person who drinks such milk will receive large doses of bacilli, which may later cause serious sickness.

Therefore, keep the flies away from the milk.

DON'TS

Don't allow flies in your house.

Don't permit them near your food, especially milk.

Don't buy foodstuff where flies are tolerated.

Don't have feeding places where flies can load themselves with ejections from typhoid or dysenteric patients.

Don't allow your fruits and confections to be exposed to the swarms of flies.

Don't let flies crawl over the baby's mouth and swarm upon the nipple of its nursing bottle.

Clean up your premises inside and out, and then, as much as you can, see that others do the same.

Strike at the root of the evil. The house-fly breeds in horse manure, kitchen offal, and the like. Dispose of these materials in such a way that the house-fly cannot propagate. Screen all windows and doors and insist that your grocer, butcher, baker, and every one from whom you buy foodstuffs does the same.

There is more health in a well-screened house than in many a doctor's visit.

After you have cleaned up your own premises inspect the neighborhood for fly-breeding places. Call the attention of the owner to them and, if he does not remove them, complain to the Board of Health.

Flies breed in horse manure, decaying vegetables, dead animals, and all kinds of filth.

NOT LESS THAN 95 PER CENT OF THE PESTS ARE BRED IN THE STABLE

All stables should have a manure bin with a door at the side and a wire screen on the top, that the larva deposited in the manure before it was placed in the bin will be screened when hatched, and, as flies seek light and come to the top of the bin, they can be easily killed by burning paper or some other device.

The fly has a thirst only equaled by his hunger; place a dish of poisoned water in the stable and a greater part of the flies hatched there will be killed.

Flies are nature's scavengers, fulfilling the same function that some bacteria do, but become an intolerable nuisance and danger when entering human dwellings and by contamination of food.

The presence of flies is a direct evidence of careless housekeeping and of the existence of filth in some form about the premises, and are more dangerous than the good housekeeper's terror found in bed-rooms.

Remember that wherever absolute cleanliness prevails there will be no flies. Look after the garbage cans. See that they are cleaned, sprinkled with lime or kerosene oil, and closely covered.

Remove all manure from stables every three or four days, and when removed keep in a tight pit or vault, so flies cannot breed in it.

Lye, chloride of lime or blue vitriol water, crude carbolic acid, or any kind of disinfectant may be used.

Keep flies away from the kitchen. Keep flies out of the dining-room and away from the sick, especially from those ill with contagious diseases.

Screen all food. Apply this rule not only to food prepared at home, but to foodstuffs offered for sale, and especially fruits, salads, and all other things which do not require to be cooked.

Prevent consumptives from expectorating where flies can feed upon it.

HOW TO KILL FLIES

To clear rooms of flies carbolic acid may be used as follows: Heat a shovel or any similar article and drop thereon 20 drops of carbolic acid. The vapor kills the flies.

A cheap and perfectly reliable fly poison, one which is not dangerous to human life, is bichromate of potash in solution. Dissolve one dram, which can be bought at any drug-store, in two ounces of water, and add a little sugar. Put some of this solution in shallow dishes and distribute them about the house.

Sticky fly-paper, traps, and liquid poisons are among the things to use in killing flies, but the latest, cheapest, and best is a solution of formalin or formaldehyde in water. A spoonful of this liquid put into a quarter of a pint of water and exposed in the room will be enough to kill all the flies.

To quickly clear the room where there are many flies, burn pyrethrum powder in the room. This stupefies the flies, when they may be swept up and burned.

If there are flies in the dining-room of your hotel, restaurant, or boarding-house, complain to the proprietor that the premise are not clean.

CAMERA ADVENTURES IN THE AFRICAN WILDS

Photographs by A. Radclyffe Dugmore. Copyright, 1910, by Doubleday, Page & Co.

TO stand before a charging rhinoceros, holding a fifteen-pound camera, and to wait deliberately until the beast is only a few feet away before releasing the shutter, knowing all the while that only an unerring bullet from his companion can turn aside the leviathan and save the photographer from being tossed 15 yards, is surely as great a test of physical and moral courage as any soldier would like to undergo. The volume which contains Mr Dugmore's photographs of wild game in Africa and also his experiences in obtaining these photographs, is one of the most thrilling, inspiring, and instructive books published in many years.*

Through the courtesy of Messrs Doubleday, Page & Company, the NATIONAL GEOGRAPHIC MAGAZINE is able to reprint eleven of the one hundred and forty remarkable photographs given to the public by Mr Dugmore. The photographs are far more wonderful and beautiful than those by the German, C. G. Schillings, which excited so much enthusiasm several years ago, and which were described and illustrated in this magazine in August, 1907.

Readers will probably find an interesting debate in the question whether photographing rhinos or photographing lions by flashlight is the more nerve-racking occupation.

Mr Dugmore secured his flashlights of lions in the following manner: He built a small hut of branches, open on one side. Outside the hut he arranged the flashlight and three cameras focused on a dead carcass, a zebra or hartebeest, a few feet away. At night he took his position in the hut and waited for the lions to appear.

* "Camera Adventures in the African Wilds." A. Radclyffe Dugmore, pp. 250, with 140 photos from life. 8½ x 11 inches. Doubleday, Page & Co., 1910. $6.00.

RHINOS FEEDING

Note the birds on their backs. These birds eat the ticks, which infest the beasts. They also act as sentinels, by their fluttering warning their companions of approaching enemies

THE LOWER PICTURE IS OF ONE OF THE SAME PAIR IN THE ACT OF CHARGING

The horn is about 24 inches long, and is composed of hair or bristles closely pressed. A rhinoceros' horn's only value is as a trophy, though some are sent to China, where they are pulverized and sold for medicinal purposes.

RHINOCEROS PHOTOGRAPHED AT A DISTANCE OF FIFTEEN YARDS WHEN ACTUALLY CHARGING THE AUTHOR AND HIS COMPANION

As soon as the exposure was made a well-placed shot from Mr. Dugmore's companion turned the charging beast

COKE'S HARTEBEEST: THIS PICTURE WILL GIVE SOME IDEA OF THE ABUNDANCE OF THE GAME IN INLAND BRITISH EAST AFRICA

LARGE HERD OF COKE'S HARTEBEEST ON THEIR WAY TO WATER

The people of Nairobi, a fair-sized town and headquarters of the railroad and government, have been compelled to build a double row of fencing around the town in order to keep out the great herds of game. The fence is, however, often broken and a zebra or hartebeest galloping through the streets is a common sight.

HERD OF GIRAFFE PHOTOGRAPHED AT A DISTANCE OF ABOUT 375 YARDS WITH THE TELEPHOTO (ENLARGED)

IMMATURE HIPPOPOTAMUS AND A CROCODILE

The birds seen on the animals' backs eat the parasites—leeches and others—which infest the coarse skin (telephoto made on the Tana River)

"For about two hours I had been straining both eyes and ears, when suddenly, to my astonishment, a huge lion appeared. He was standing close to the zebra when I first discovered him, and I could not understand how he could possibly have come without being seen or heard. Yet there he stood, the king of beasts, the most feared animal in Africa, not twelve yards away."

The lions weigh on an average over five hundred pounds each, and yet their approach was so silent and stealthy that Dugmore always failed to detect their coming until the tearing of flesh and breaking of bones of the bait proclaimed their arrival.

By pressing the electric button the flash was then fired, but the lions would only retreat for one hundred or two hundred yards, where they would make the night hideous with their roaring. It was then the pleasant duty of the photographer to emerge from the protection of his hut, reload his three cameras and the flashlight apparatus, while the chorus of the lions continued. On one night Mr Dugmore secured photographs of twelve different lions.

Mr Dugmore speaks most enthusiastically of the wise precautions taken by the British government to prevent the extinction of game. In addition to the regulations forbidding the shooting of game along the railways, the authorities have set aside about 10,000 square miles as a reserve in which no shooting is allowed. The abundance of game in the free-zone is simply extraordinary.

"We could see countless herds of animals," hartebeest and gazelles, zebra, elands, etc. "Our excitement reached its highest pitch when we discovered a large giraffe standing complacently, scarcely one hundred and fifty yards from the snorting train. How different the huge creature looked in his natural state from those we had seen in zoos or menageries! How different the deep, rich coloring and the dark, well-defined markings from the faded coat of the beast in captivity! This splendid animal, towering above the small trees, after watching us for a few seconds, ambled away to what he considered a safe distance."

The most unpopular of all the animals in British East Africa, says Mr Dugmore, are the zebras.

"They looked like painted ponies with their strongly defined black stripes, and were beautiful beyond words. It is curious how they appeal to the new arrival, while, if you speak to the settler of the zebra as being even worthy of notice, he smiles sadly, and commences a torrent of abuse against what he considers one of the worst pests of the country. They would like to see them wiped off the face of the earth, and the handsome creatures are killed in great numbers to be used as food for the native workmen, or even for the dogs. And yet they can scarcely be said to be decreasing except in very restricted areas.

"The cause for this common dislike of the zebra is his objectionable habit of disregarding fences. A herd will stampede, and ten or twenty panels of a barbed wire fence are down like a flash, and then, as likely as not, they will wheel round and repeat the operation at another point. In places where fences are measurable by miles, it is of the most importance that they should be kept in a good state of repair. The destruction of a few panels may mean immense damage to crops, and perhaps the loss of valuable ostriches; hence the settlers' lack of love for the cantankerous, though beautiful, zebra.

"So far no practical use for the animal has been discovered. They are not easily tamed and, generally speaking, are extremely bad-temperad, so that they are most difficult to break or handle, and it is almost certain that they are not worth the trouble, owing to their lack of stamina. Contrary to popular opinion, they are not very fast, and have no staying power."

The huge and clumsy hippo conceals in its immense mouth teeth which sometimes attain a length of over five feet, and yet this gigantic pig eats only grass.

"The beast is frequently shot for its ivory, which is quite valuable. Then,

A GROUP OF BUFFALO RESTING AMONG DENSE BRUSH

This telephoto was made when the sun was very low and the wind blowing with such vigor that a time exposure was impossible, hence the blackness of the shadows, where the buffalo can scarcely be detected

A LIONESS ABOUT TO COMMENCE HER DINNER: THE HARTEBEEST HAD BEEN KILLED BY LIONS DURING THE PREVIOUS NIGHT

This flashlight was made when the animal was ten yards from the author

THE SAME LION AS SHOWN ON THE OPPOSITE PAGE, BUT PHOTOGRAPHED FROM A DIFFERENT POSITION

Zebra is the favorite meat of the lion

FLASHLIGHT PICTURE OF THE KING OF BEASTS

At the moment the photograph was made the lion was twelve yards from the author and his companion, who were on the ground beneath some thorn bush

too, their meat is probably more appreciated than that of any other African animal, the immense quantities of fat being greatly relished.

"Agriculture and the hippopotamus do not go hand in hand, as a single hippopotamus will in one night destroy acres of crops; consequently the animals are not much loved by either the native or European farmers.

"The hippopotamus is usually a nocturnal feeder. He spends most of the day in the water, though he may be frequently seen on rocks or sand bars enjoying his sun-bath. As evening approaches he becomes restless, and usually soon after the sun sets he begins to think of dinner. At this time the herd separates, each individual going, I believe, to his own favorite feeding-ground. Whether they feed every night I am not quite sure, for I have noticed certain individuals keeping to a pool all night, while it is not at all an uncommon thing to see them at night asleep on sand bars.

"Certain landing places are used regularly and, judging from the way the banks are worn down and rocks polished, it would seem as though these places have served for many centuries. How far they will go from their day pool is hard to say, but there is every reason to believe that they will sometimes travel ten or fifteen miles or more before landing. Then when they are ashore they will often go a long way before finding the necessary supply of the grass which forms their food.

"It is scarcely credible that such large beasts (for a full-grown bull will probably weigh over three tons) can find enough nourishment in grass, but of course in porportion to their size they do not require nearly as much food as animals of more nervous temperament and active habits of life."

In addition to the lions, rhinos, hippos, and giraffes, most interesting are Mr Dugmore's photographs and descriptions of the filthy spotted hyena, of hartebeests, tiny dik-dik, elands, warthogs, gazelles, oryx, impala, waterbuck, Grevy's zebra, vultures, marabou storks, and other animals, and of the extravagant vegetation.

Several entertaining chapters are devoted to an account of the little-known country around Meru and the native dances.

"The women do most of the heavy work, and it is no uncommon thing to see a girl of perhaps twelve or thirteen carrying a seventy or eighty pound load of firewood on her back, with a bag of corn or a huge gourd of water on the top of it. These are hung by a strap from the head, which is usually clean-shaven. In front, more often than not, hangs a baby, which complacently sucks at its mother's breast as she walks along. The father marches in front, carrying no more than his spear and knob stick, his body smeared with a sickening mess of red earth and grease.

"The costume of the men is usually a red blanket or a brown cotton cloth hung from one shoulder, while the neck, wrists, arms, ankles, and below the knees are decorated with beautiful little beaded bands of wire. Frequently they dispense with covering of any kind. The women wear a short skirt of leather with or without bead work. It is fastened below the breasts and parts in front, so as to leave the knees free.

"Heavy wire ornaments are usually wound around the legs, arms, and neck, and sometimes immense waistbands or beads and cowries are worn. Ear ornaments are used by both sexes, the women preferring clusters of large beaded rings, or heavy wire. In both cases the lobe of the ear is cut and stretched enormously by means of wooden or bone discs.

"It is curious that the women have the head clean-shaven, or nearly so, while the men do their hair, or wool, in most fanciful ways, usually filling the fine braids with a mixture of their favorite red earth and grease. The people are chiefly agriculturists, their live stock consisting almost entirely of goats, sheep, and poultry. The sheep are rather small, and are the fat-tailed variety; the poultry are also small, and lay eggs not much larger than those of the bantam."

THE FIRST TRANSANDINE RAILROAD FROM BUENOS AIRES TO VALPARAISO

By Harriet Chalmers Adams

ARGENTINA and Chile were neighbors, but they could not well be sociable with a mountain barrier between. A passage, however, has at last been opened through the towering, snow-clad Andean wall, and enthusiastic crowds in Buenos Aires and in Santiago de Chile have sped departing trains bound for the adjacent territory. The great Transandine Railway is completed.

On the 5th of last April the Transandine tunnel, the final link in the 888 miles of rail connecting Buenos Aires and the Atlantic with Valparaiso and the Pacific, was officially opened on the Chilian side of the mountains at Caracoles station.

It was a fitting day for a Chilian celebration, since it commemorated the anniversary of the patriotic battle of Maipó, dear to the heart of every native of the far south as the greatest and final victory in the war of independence. Many prominent men of the Republic were present, including members of the cabinet, and at the banquet subsequently held in honor of this historic event Argentina's representatives were entertained before their return to their own country on the other side of the tunnel.

Argentina's official opening of the road was postponed until the 25th of May, which is not only Independence Day in the Republic, but also the inaugural date of the Centenary Exhibition.

The chief feature of this most important of international expositions yet to be held in Latin America is, very appropriately, a railway exhibition, agriculture and art taking secondary place. Buenos Aires, the fourth metropolis of the Americas, the second Latin city of the world, the first Spanish-speaking center, is to be the scene, for six months, of a brilliant demonstration of progressive Argentina's marvelous development. Modern, industrial Argentina has been created by her railways, which not only cross the country from the Atlantic to the Andes, but penetrate those semi-tropical lands adjoining the verdant Republic of Paraguay on the north and those bleak, wind-swept pampas on the south bordering the old Patagonian frontier.

INITIATED BY A MASSACHUSETTS MAN

The story of the Transandine Railway, from its earliest projection by a North American captain of industry to its final completion by an Anglo-American syndicate, is worthy of a prominent place in engineering annals.

William Wheelwright, a native of Newburyport, Massachusetts, was the first to conceive the idea of a transandine road. The plan, which he outlined in 1860, called for the building of a railway from Caldera, on the Chilian coast, eastward through the mountain pass of San Francisco, and thence across the pampas of Argentina to Rosario, a port on the Paraná River—a more northerly route than the one finally adopted.

To the indomitable zeal of the Chilian brothers, Juan and Mateo Clark, however, is due the major honor of the actual achievement. When, in 1872, having fulfilled their contract for the installation of a telegraph line across the Andes, they applied to the Argentine Congress for railway concessions from Buenos Aires to the Chilian frontier, they were regarded by many as idle dreamers. Yet one of the brothers, happily, has lived to realize the triumphant fulfillment of his dream.

In 1874 the Argentine concessions were obtained by the Clarks; in 1878 the contract was signed; but many obstacles arose and it was not until 1886 that a company—The Transandine Railway—

Photo from W. R. Grace & Co.

THE SALTO DEL SOLDADO BRIDGE ON THE TRANSANDINE RAILROAD

Photo from W. R. Grace & Co.

STATION OF USPALLATA, ARGENTINA

was incorporated to carry out the undertaking. Actual work on the road was at last commenced, and in 1888 the first train left Mendoza, bound westward toward the Andes. The construction now continued steadily until 1891, when work was suspended for eight years.

Meanwhile the Clarks had obtained a Chilian concession for a railway from Valparaiso eastward to the Argentine frontier, and work on this end of the line was begun in 1889. Eventually the Clark brothers were obliged, through financial embarrassment, to give up these concessions, and both divisions came under the control of an English company.

In 1899 work on the Argentine side was resumed and steadily prosecuted until the approach of the summit tunnel was attained. Construction on the Chilian side, on the contrary, progressed slowly, and it was not until 1903, when W. R. Grace & Co., of New York and London, were awarded the contract of completing the road, that work at the western end was energetically carried on. In 1906 an agreement was entered into by the companies representing the road on the two sides of the Andes.

THE SUMMIT TUNNEL: A MARVELOUS ENGINEERING FEAT

It was agreed to pierce the summit tunnel, the final connecting link, by means of the same contractors and under one control and authority. The result has demonstrated the wisdom of this decision.

The drilling of this unique passageway, two miles in length and situated two miles above the sea (although 2,000 feet below the mule trail over the mountain pass of Uspallata—12,605 feet), was a stupendous undertaking. Fortunately, engineering science, and improved appliances for tunneling in particular, has made great strides since those early days when the Transandine was projected—when the piercing of this Cumbre, or Summit, tunnel was reckoned as an in-

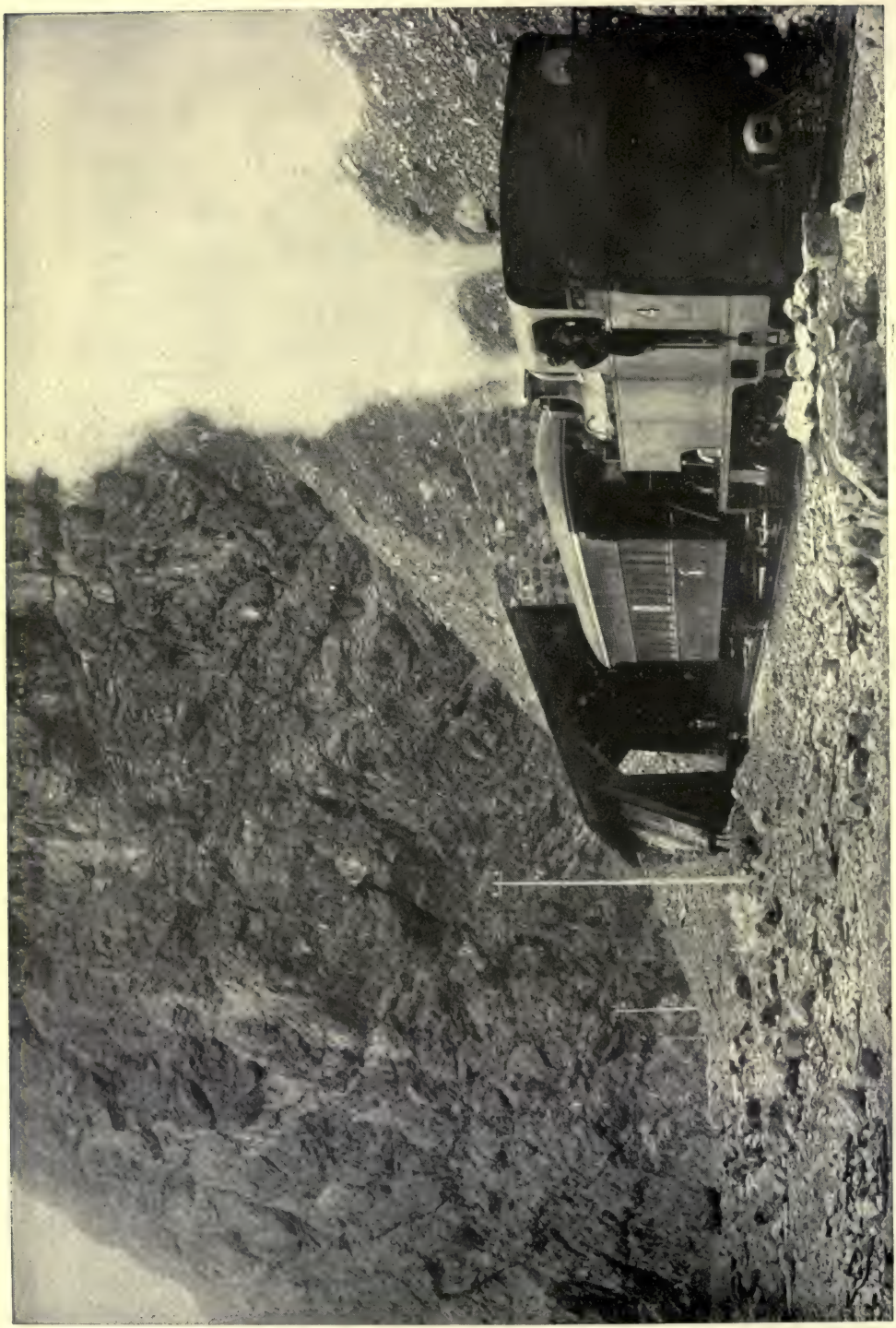


Photo from W. R. Grace & Co.

SNOW-SHEDS AT THE ENTRANCE OF ONE OF THE TUNNELS OF THE TRANSANDINE RAILROAD

SKETCH-MAP OF RAILROAD FROM BUENOS AIRES TO SANTIAGO, 888 MILES LONG

superable obstacle in the completion of the road. It was on November 27 of last year that the workmen, approaching from opposite sides of the tunnel, faced the last rocky barrier preventing Argentine and Chilian traffic by rail. It was an old Italian, Felipe Fascio, for many years employed in similar Alpine undertakings, who placed the final fuse of demolition. So came about the conquest of the Andes, and the Buenos Aires-Valparaiso rail route is at last a reality.

It is expected that the "Transcontinental Express" will make the through journey from coast to coast in about 34 hours. Before the completion of the road, when the missing rail gap was covered by diligence and saddle during the summer season (October to May), 3½ days were necessary for the journey. During the winter months of June, July, August, and September, when the Andean snows made passenger traffic at all times dangerous and often impossible, the sea voyage by way of the Strait of Magellan from Buenos Aires to Valparaiso occupied a period of about 11 days. Well-built snow-sheds in the Andean section will now insure safe passage for trains, even under the most unfavorable weather conditions.

DIFFERENCE IN GAUGE A SERIOUS INCONVENIENCE

The Transandine Railway is not, as many suppose, one continuous line under one management, a number of companies being associated with the undertaking. "The Buenos Aires and Pacific Railway" (Buenos Aires to Villa Mercedes), "The Argentine and Great Western Railway" (Villa Mercedes to Mendoza), and "The Argentine Transandine Railway" (Mendoza to Argentine frontier) are three distinct organizations, but have, quite recently, come under the management of the first-named company. "The Chilian Transandine Railway" (Chilian frontier to Los Andes) and "The Chilian Government States Railway" (Los Andes to Valparaiso) are each under separate management.

There is one serious drawback in this railway communication between the two oceans, and this is a matter of gauge. "The Buenos Aires and Pacific" and "The Argentine Great Western" are broad-gauge roads, while "The Argentine Transandine" and "The Chilian Transandine" are narrow gauge, and "The Chilian Government States" broad gauge again. This necessitates a transshipment of goods on both sides of the Andes—at Mendoza, the terminus of "The Argentine Great Western," and at Los Andes, where the two Chilian roads connect. These two changes naturally tend to the making of unduly high freight charges as compared to those now ruling on the longer sea route.

THE POSTMAN OF THE SNOWS

"Across the Andes," meaning the old route via diligence and saddle from Las Cuevas, the former terminus of the railway in Argentina, to the Chilian town of Caracoles, where the traveler again

A STATION ON THE RAILROAD BETWEEN ARGENTINA AND CHILE Photo from W. R. Grace & Co.

Photo from Harriet Chalmers Adams

PASEO DE JULIO, THE WATER-FRONT BOULEVARD OF BUENOS AIRES, THE BEAUTIFUL

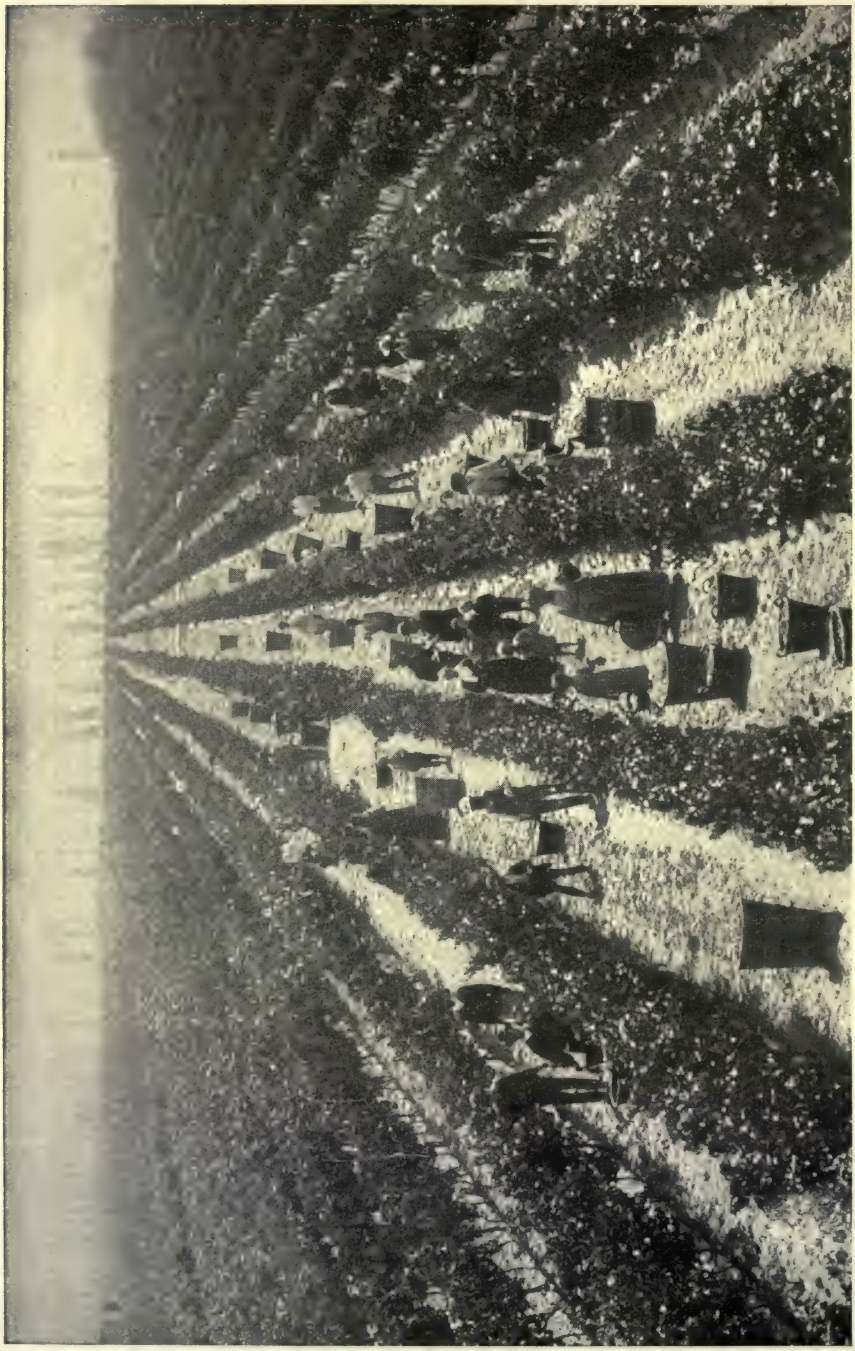


Photo from Harriet Chalmers Adams

THE HEART OF THE VINE INDUSTRY, NEAR MENDOZA (SEE PAGE 410)

boarded the train, is now an experience of the past.

Of the past, too, are those unsung heroes, the mail-carriers of the mountains, laden with letters and packages marked "Via Cordillera," who braved the bitter cold and the savage snows of the Andean winter. It was about the middle of May, under the old régime, when the stage-coach companies suspended traffic, employees and stock making their way to the lowlands.

Rain and blizzard, sleet and snow, now were masters of the uplands, and avalanches "rushed madly down the mountain sides." No pen picture can describe the hardships and privations endured by the men then entrusted with the mails. The precious burden was carried in leather bags strapped to the back, and a curious foot-gear called the "*tomango*" was worn. It consisted of a sheepskin wrapped around the foot, with the fur next to the skin, this unwieldy hose being bound to the leg by thongs of leather which supported an immense leather sole. A poncho, woolen trousers, a long stick with a steel spike, and a small bag containing rations (dried meat, biscuit, and onions) completed the outfit.

The government has built small stone refuge huts (*"casuchas"*) along the trail, and into one of these cheerless shelters the exhausted postman of the snows crept at nightfall, shivering through the dark hours, for there was seldom wood obtainable for fuel. Nature resents man's intrusion into her ice-bound domain, and frost-bites are her usual punishment in the Andes. Only too frequently men lost their way in the newly fallen snow—and the mail never reached its destination.

An American now living in Chile made a winter journey across the Andes last season, and he pays a glowing tribute to these "big children of the mountains," the mail-carriers, who were his companions.

"They are the bravest and sturdiest creatures on the face of the earth and have hearts of gold," he writes. "Their wrinkled, leather-like faces bear the marks of the terrible adventures which they related to me, as we huddled together for warmth under the life-saving oven-shaped shelter during the long, bitter night."

THE PARIS OF THE NEW WORLD

When it is autumn here in North America and we are beginning to think of furs, it is Primavera (first-view), or spring-time, and the peach trees are blossoming in Argentina and in Chile. It is then that the traveler bound across the mountains has a comparatively comfortable journey. We will start from Buenos Aires, traverse the width of Argentina, and cross the Andes into Chile in the old way.

There is hardly a capital in Latin America that has not at some time been labeled "the Paris of the New World." I have visited them all, from Mexico City to Santiago de Chile, from Havana to Panama, and, in my opinion, the title belongs alone to Buenos Aires.

Well built and progressive, artificially beautiful and of cosmopolitan air, the metropolis of Spanish America is a city of which the Argentinos may well be proud. It ranks among the great capitals of the world. The traveler is loath to leave its four miles of splendidly constructed docks, where the flags of every nation wave (save that of the United States of America); its brilliantly illuminated avenues and dazzling cafés; its beautiful Park of Palermo, where the best-gowned women of the South, the pride of the Paris modiste, fascinate the beholder as they drive by in their perfectly appointed victorias. Although founded nearly four centuries ago, Buenos Aires seems as modern as Chicago.

The people who live in this city near the mouth of the Silver River are termed locally *Puerteños*, or "Keepers of the Gate," while those outside the glittering capital, on the vast almost treeless pampa stretching away to the foothills of the Andes, are dubbed *Campoñeros*, of El Campo (the country), or "The Camp."

Buenos Aires is the gorgeous outer

STARTING ACROSS THE ANDES IN THE DAYS BEFORE THE RAILROAD Photo from Harriet Chalmers Adams

The curious leggings are sheepskins wrapped around the foot with the wool next the skin (see page 405)

THE COWBOYS OF THE PAMPA

garment, but the heart of Argentina lies beyond the merry throngs, far beyond the fashionable suburbs of Belgrano and Florista, out on the boundless pampa, through which we will journey by rail.

"The International Express" leaves Buenos Aires in the morning, so we have a day's view of the country stretching southward from the railway before the foothills are reached. The longest straight stretch of track in the world (175 miles) lies between Vedia and Mackenna, on this line.

ARGENTINA EXPORTS MORE FOODSTUFFS THAN THE UNITED STATES

The development of Argentina has been nothing short of marvelous. The Republic is one of the few countries in the world today with advancing trade values. In 1909 there was a yearly gain of $61,000,000 in foreign commerce, and the exports exceeded the imports by more than $94,000,000. The wool and frozen-meat industries have developed rapidly, and when it comes to grains the figures are simply amazing. Two and one-half million tons of wheat and over two million tons of corn went out of the country last year to feed the hungry people of the world. The United States of North America now plays second fiddle to a southern sister in the exportation of foodstuffs. Argentina leads the world in the exportation of grains.

Many of the ranches, or "estancias," in "The Camp" are owned by Britishers. The men who do the work, however, the cowboys of the Pampa, are the *Gauchos,* who are, as a rule, native born. Inferior physically to our cowboys of the West, these men are far more picturesque in costume. They are especially fond of ornamentation—fringed leather and silver trappings, tight boots with silver stirrups, and their saddles are bedecked in a similar fashion. With the encroachment of the railroads and modern civilization, the *Gaucho* is losing much of the old-time charm so long associated with his name, but, with his wild life and his combats, his songs and his dances, he still plays the star rôle in "The Camp."

On our journey across the country we see many of these unique ranchmen at the railway stations. At Rufino, half way to Villa Mercedes, the low-lying land is covered with water, and myriads of ducks, gulls, and other water fowl

CAMP MUSICIAN ON THE PAMPA

Photo from Harriet Chalmers Adams

TYPES OF THE HIGHLANDS: BORDER OF ARGENTINA AND CHILE

Photo from Harriet Chalmers Adams

darken the ponds as far as the eye can reach.

After leaving Villa Mercedes we are on "The Argentine and Great Western" until we reach Mendoza, where we change to the narrow gauge of "The Argentine Transandine." If we have anticipated any discomfort, thus far we are agreeably disappointed. We have journeyed in a comfortable "sleeper" and have voted the "diner" excellent.

Mendoza is a hustling little town in the heart of the wine industry. Many Italians come here annually from the mother country to work in the vineyards, returning to Europe when the season is over.

In the past much Chilian wine has found its way across the border, but this export is decreasing with the remarkable development of the wine industry in the Argentine province of Mendoza. The export from Argentina into Chile is mainly that of cattle. Many of the staple commercial products of the two republics are now identical, and it is feared that the producers on either frontier will clamor for protection against one another, now that there is an easier method of transportation. Argentina's important exports of grains, hides, and beef, and Chile's nitrates and copper will be sent abroad by sea as heretofore, but the manufactured goods imported into these countries from Europe and America will probably cross the continent by rail.

THE CHRIST OF THE ANDES

Leaving Mendoza, we begin to climb, and the temperature falls as the altitude increases. At Puente-del-Inca there is a natural bridge spanning the mountain torrent. Here are situated the famous medicinal baths (more accessible to Chilian invalids since the opening of the Summit tunnel). Arriving at Las Cuevas, we leave the train, an army of beponchoed guides and sturdy mules awaiting us. We and our heterogeneous belongings are to be borne by the patient little beasts up over the Cumbre, 12,605 feet above sea-level. Great trunks and hat-boxes bearing flaring European labels, golf clubs, tennis rackets, bags, and boxes of all sorts and descriptions are loaded on panier-wise, and off we all jog on a trot for Chile.

A good-natured crowd of passengers usually, these who cross the Andes, making light of cold and of unaccustomed mounts. It is a different story in the Andean passes farther north, where the occasional wayfarer endures extreme hardships. The Pass of Uspallata has been a highway for so many years that its rugged walls no longer look formidable to the summer traveler.

Less than an hour after leaving Las Cuevas we reach the summit and pause to marvel at the panorama. The guides, meanwhile, arrange saddles and tighten girths for our slide down the Chilian wall. Snow-crowned mountains rise on every side, salient rocky peaks here and there piercing the blue. Dominating the heights, yet ruling through the power of love rather than of might, "The Christ of the Andes" stands on the summit, on the borderland of the two republics.

Cast from the cannon of the two nations, this symbol of peace and fraternity was erected at the time of the border dispute, when the King of England acted as arbitrator. On a gigantic column, surmounted by a globe on which the configuration of the earth is outlined, this colossal figure, 26 feet in height, stands holding a cross in one hand, extending a blessing with the other.

The conception of such a monument came from the hearts of two natives of Argentina, Bishop Benavente and Señora de Costa. It was the splendid woman, Señora de Costa, who, as president of the Christian Mothers' Association of Buenos Aires, undertook the work of securing funds for the creation of the statue. The Argentine and Chilian authorities were later interested in the work and, in March, 1904, three thousand Argentinos and Chilians assembled to witness the unveiling of the monument. The venerable Bishop Benavente himself offered up a solemn mass and blessed the peace flag, which embodies the colors of all the flags of the Americas.

Courtesy of Bulletin of Bureau of American Republics

PROFILE OF THE TRANSANDINE TUNNEL BETWEEN CHILE AND THE ARGENTINE REPUBLIC

STONE REFUGE-HOUSE IN THE ANDES

Photo from Harriet Chalmers Adams

Houses of this character have been built at short intervals along the dangerous parts of the highways over the Uspallata and other frequented passes of the Chile-Argentine Andean Range, the first one having been erected in 1791 by Governor Ambrosio O'Higgins. Violent storms sometimes overtake travelers crossing the mountains, and refuge is afforded in these houses until the fury of the tempest abates (see page 405).

IN THE ANDES OF CHILE

Photo from Harriet Chalmers Adams

Photo from Harriet Chalmers Adams

"THE CHRIST OF THE ANDES," ON THE SUMMIT OF THE CORDILLERA BETWEEN CHILE AND ARGENTINA

(SEE PAGE 410)

The motto on this banner proclaims "Peace to all nations," while the statue's base bears in Spanish the following legend: "Sooner shall these mountains crumble into dust than the people of Argentina and Chile break the peace which they have sworn to maintain at the feet of Christ the Redeemer." Long may this symbol of everlasting love guard and guide the two great sister republics of the far south!

ON THE CHILIAN SIDE

It is not an exaggeration to say that we slide down to Caracoles, in Chile. The sure-footed little mules following in the rear resemble alighting aeroplanes, their loads projecting like wings. It is a half hour's jog to the little railway station of Caracoles, and we are off for Los Andes. Down steep grade, through tunnels cut out of solid rock, across many a bridge, we fly; down from the forbidding heights into the zone of farms and on to the lovely, verdant valley, where the pretty town of Los Andes nestles in the shadow of Aconcagua, the highest mountain in the Western Hemisphere.

The mountains which guard the Pass of Uspallata are merely little brothers of the giant Aconcagua, which towers 23,300 feet above sea-level. Those who have attained its summit tell of the incomparable view; of the sheer drop of 10,000 feet to the east; of the vast expanse of snow-clad mountains to the north and south; of the declining peaks to the west, diminishing into the green Chilian lowlands, which melt into the far-away sea.

At Los Andes we again change cars for the capital. Santiago de Chile rivals in situation every capital in the New World, with the exception of Rio de Janeiro. The emerald of its surrounding meadows is in sharp contrast to the towering mountains in the background. After sunset Santiago seems of heaven rather than of earth. Then the *Cordillera de los Andes* gleams flame and gold ere a mantle of purple plush envelops the valley. Less dazzling than Buenos Aires, less practical than Valparaiso, Santiago de Chile possesses a dignity foreign to these others, with more of the Old World charm.

Valparaiso we reach by express in a few hours. It is a half Chilian, half Anglo-Saxon city. The British have come to stay in this great South Pacific seaport. The British-Chilian combination, like the American-Chilian, produces a splendid type. Travelers class as the beautiful harbors of the world Rio de Janeiro, San Francisco, Sydney, Naples, Constantinople, and Cork. We add Valparaiso to the list of portal queens.

And so we have crossed the continent in a little over three days. Via the Summit Tunnel we will cross in 34 hours. The Christ of the Andes will always have its pilgrims; the peasants will follow the trail in the footsteps of their fathers; but the traveler will choose the easier route and will forsake the Cumbre and the mule.

OTHER NOTABLE SOUTH AMERICAN RAILWAYS

In writing of the Transandine, the other important railroads of South America come into view. In Peru are the two highest railways on earth, the Oroya and the Southern Railway. On the Oroya it is possible to climb over 15,000 feet in a single day from the Pacific Ocean to the roof of the Western world. These two roads are a monument to the late Henry Meiggs, a North American engineer. In Northern Peru projected lines cross the Andes and drop down into the Amazonian Valley. In northern Chile railways also ascend to the highlands, and a line nearing completion will connect the Chilian port of Antofagasta and Bolivia's picturesque capital, La Paz, with the northern towns of Argentina.

In Brazil the railways are striking westward from the coast, aiming for Matto Grosso, the rich inland province of the mighty republic. The far-famed interior Madeira-Marmoré road is progressing rapidly. Quaint Quinto is now reached by rail from its port, and Bogatá is connected with its river highway, the Magdalena. Lesser lines in existence

Photo from E. N. Carpenter

CHILIAN SOLDIERS GREETING THE FIRST TRAIN FROM ARGENTINA ON THE TRANSANDINE RAILWAY

and in projection throughout the continent add their note to the "Song of the Ties," and we shall live to see more than one other Transandine railway, although the completed Pan-American road belongs to the far-distant future.

This first transcontinental railway of South America marks a new era in the continent's commercial history, and in our own. With the opening of the Panama Canal we North Americans will have a golden opportunity to win from Germany and England the trade which is ours by the right of contiguity. Through gross lack of understanding of our Southern neighbors, we have lagged behind in the commercial race. European nations have intelligently developed trade with Latin America, but it is only in recent years that we have followed in their wake.

The Transandine Railway sounds the bugle call, not alone of Argentine and Chilian development, but of the growth and prosperity of the entire continent. We owe better acquaintance to our Latin sisters. We owe commercial advancement to ourselves. Ships should carry our flag into Southern waters. We should take first rank in the near future in South American trade.

THE FIRST TRANSANDINE TRAIN

A MEMBER of the National Geographic Society, Mr E. N. Carpenter, of Wilkes Barre, Pennsylvania, who happened to be in Chile in April, participated in the formal opening of the Transandine Railway, April 5. From his letter to the Society the following is printed:

"The special train left Santiago, Chile, Monday, April 4, with about 150 guests, including cabinet ministers, senators, deputies, and government officials. We were comfortably quartered that night in the railroad hotel at Los Andes, from which point the railroad is one-meter gauge to Las Cuevas, on the Argentine side. The altitude of Los Andes is 824 meters and that of the tunnel, 43 miles distant, 3,200 meters. The rack railroad begins at Rio Blanco, on the Chilian side, and climbs 6,000 feet in the 26 miles to the tunnel.

"Our train left Los Andes in two sections early Tuesday morning, April 5, and, after several brief stops, finally reached Carracoles, at the mouth of the tunnel, where it was made up in one section. We then proceeded into the tunnel, where, at the international boundary, which was marked by a string of colored incandescent lights, we met the train carrying the Argentine delegation from Buenos Aires. Greetings over, both trains returned to Carracoles, where we were received by a body of Chilian infantry, while the band played the national airs of Chile and Argentina. A large tent had been erected in which "almuerzo" was served, followed by speeches by prominent representatives of both countries.

"This over, the Chilian train escorted the Argentine delegation through the tunnel to Las Cuevas, and, after farewells were said, both parties started on their homeward journey, we reaching Santiago late the same night."

FEDERAL FISH FARMING; OR, PLANTING FISH BY THE BILLION

By Hugh M. Smith

U. S. Deputy Commissioner of Fisheries

IT was nearly forty years ago that the United States Government first awoke to the necessity of conserving the aquatic resources of the country, and began those operations in behalf of fishes, fishermen, and fish-eaters that have now attained such gigantic proportions.

Several of the States had already established their local fish commissions or boards when in 1871 Congress took the initial step toward a national fishery service by the passage of a joint resolution creating the office of commissioner of fish and fisheries.

The early years of the Bureau of Fisheries were devoted to an investigation of the condition of the fisheries of the Atlantic coast, Great Lakes, and other sections; to studies of the interior and coastal waters and their inhabitants, and to exploration of the off-shore fishing banks. The cultivation of useful fishes was soon taken up throughout the country, and quickly attained large proportions. The natural expansion of the work was materially augmented from time to time by acts of Congress, and in a comparatively short time the operations came to have a very wide scope.

From year to year, as the importance of the work has become increasingly evident, additional hatcheries have been built, the capacity of existing hatcheries has been enlarged, the scale of the operations has been extended, and new kinds of fishes have been added to the output.

Today there is scarcely a phase of aquiculture, of the fishing industry, or of biological and physical science as connected with the waters, that does not come within the purview of the bureau.

CULTIVATION OF FOOD-FISHES

It is conceived to be the better policy to expend a small amount of public money in making fish so abundant that they can be caught without restriction and serve as cheap food for the people at large, rather than to expend a much larger sum in preventing the people from catching the few fish that still remain after generations of improvidence.

Public or government fish-culture in America exceeds in extent and importance that of all other countries combined. However, the neglect of some of the states to provide the minimum protection to certain species inhabiting interstate and international waters has not only negatived the fish-cultural work of the bureau and of the states themselves, but has practically inhibited it by preventing the possibility of securing an adequate supply of eggs, thus making desirable and necessary the placing of interstate and international waters under the jurisdiction of the general government.

At the end of the first ten years of the bureau's existence, the fishes that were being regularly cultivated were shad, carp, chinook salmon, Atlantic salmon, land-locked salmon, rainbow trout, brook trout, and whitefish, in addition to which the propagation of several others had been undertaken experimentally. The list now is six times as long and the annual output is ten times the aggregate for the ten-year period ending in 1881.

The main energies are devoted to the important commercial fishes—shad, whitefish, lake trout, Pacific salmons, white perch, yellow perch, cod, flatfish—and the lobster, which are hatched in lots of many millions annually. More widely popular, however, are the distributions of the fishes of the interior waters which are generally classed as game fishes. Although representing only about 10 per cent of the output of the hatcheries, this feature of the work is very important,

HATCHERY CREW MAKING A PLANT OF SHAD FRY ON A NORTH CAROLINA SOUND

Shad culture in North Carolina is now more successful than in any other State, owing chiefly to the support given the government by the State authorities (see pages 429 and 435)

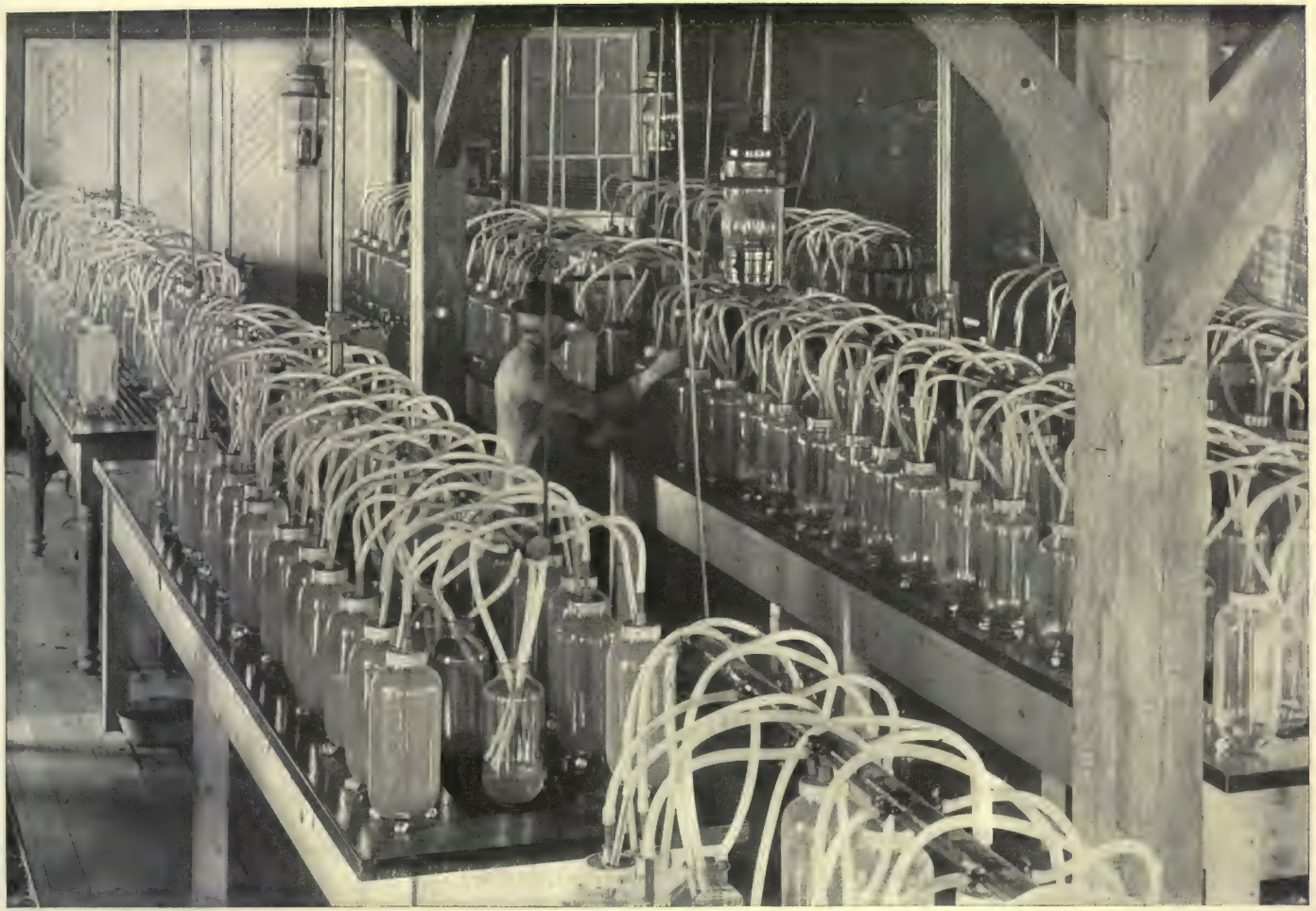
for it supplies choice kinds of fish for public rivers, lakes, and ponds, and for fishing preserves and private ponds and streams in all parts of the United States. The fishes most in demand for these purposes are the land-locked salmon, the different species of trout, the grayling, the basses, the crappies, the sunfishes, and the catfishes, but various others also are handled.

NATIONAL FISH NURSERIES

Fish-cultural stations are established by special act of Congress, and their location and construction are determined after a careful survey of the available sites in a given state. The usual buildings are the hatchery proper, a residence for the superintendent and his family, and necessary outbuildings. At some stations there may be also power house, foreman's or fish-culturist's dwelling, mess hall, and stable. The superintendent's and other quarters are furnished gratis, but station employees provide their own subsistence.

The only permanent marine hatcheries are in Maine and Massachusetts, where the cod, pollock, flatfish, and lobsters are hatched in immense numbers. Other sea fishes that have in previous years been artificially propagated and may again come under the hand of the fish-culturist are the haddock, the scuppaug, the sheepshead, the sea bass, the mackerel, and the squeteague, some of which were hatched on the steamer *Fish Hawk* in Chesapeake Bay and Florida.

The fish-cultural work on the eastern coast streams was centered at 6 hatcheries and subhatcheries in 1909. At 1 of these the principal species handled is the Atlantic salmon, at 4 the shad, at 3 the yellow perch, at 2 the white perch, and at 1 the striped bass. In recent years the bureau has operated a shad hatchery on the



INTERIOR OF A SHAD HATCHERY IN THE CHESAPEAKE BASIN

The semibuoyant eggs of the shad are incubated in glass jars, from 85,000 to 100,000 eggs being put in each jar. The shad fry emerge in 3 to 10 days and are soon planted (see pages 429 and 435)

Delaware River, and has detailed the steamer *Fish Hawk* for shad hatching in Maine, New Jersey, North Carolina, and Florida. The central station, in Washington, is operated largely for experimental and exhibition purposes.

In order to counteract the effects of the very exhausting fisheries of the Great Lakes, the government has maintained hatcheries for many years, and now operates 6 belonging to the United States and 2 belonging to the State of Michigan. The fishes to which attention is given are those which enter most largely into the catch of the fishermen, namely, the whitefish, cisco, lake trout, and pike perch, the annual output of which now exceeds one and a half billions. Under arrangement with the Canadian authorities, two egg-collecting stations for whitefish, cisco, and lake trout are maintained at points in Ontario.

The hatcheries on the rivers and lakes of the Pacific coast are devoted almost exclusively to the various salmons. In California, where the bureau established a salmon hatchery as early as 1872, there is one central or main station, at Baird, on the McCloud River, with important collecting stations on two other tributaries of the Sacramento. In Oregon a central hatchery at Oregon City, on the Willamette River, has 3 subhatcheries on tributaries of the Columbia, in Oregon and Washington, and 3 subhatcheries on tributaries of the Rogue River, Oregon, in addition to several egg-collecting stations.

The interests of the large salmon fisheries of the Puget Sound region are safeguarded by a hatchery on Baker Lake, on the Skagit River, Washington, and will soon be further aided by several other nurseries for which Congress has made provision. The two latest additions to the western salmon hatcheries are at Yes Bay and Afognak, in Alaska, at which points immense numbers of blueback or sockeye salmon are now being put forth.

SHAD AND STRIPED BASS IN PACIFIC

A significant feature of artificial propagation on the Pacific seaboard is that in the Columbia basin the hatching of the acclimatized shad has begun on a small scale, and in the Sacramento basin the cultivation of the acclimatized striped bass has commenced under conditions which indicate that more eggs of this species may be obtained in California than in any of the States to which the fish is native.

The hatcheries in the interior regions constitute the most numerous class, and their output reaches the largest number of people. Their operations are addressed chiefly to the so-called "game" fishes, which, while caught mostly by anglers, nevertheless constitute an important element of the food supply. At these stations large numbers of fish are reared to the fingerling or yearling sizes before being released; for this purpose more or less extensive pond areas are required.

A peculiar kind of station which is included in this general class is that devoted to the collection of fishes of various kinds obtained from the overflows in the upper Mississippi Valley. In the lowlands along the streams in this region the spring floods receding leave disconnected sloughs and pools, which either become dry during the summer or, if they remain until the winter, freeze solid, and the immense numbers of bass, crappy, and other desirable-species therein are lost in the ordinary course of events. By seining these waters the bureau obtains large numbers of fish that would otherwise perish, returning some of them to their native streams and distributing others to adjacent waters.

ENORMOUS OUTPUT OF THE HATCHERIES

The fish-cultural work of the federal government has now attained a magnitude that cannot readily be comprehended, and is increasing at an exceedingly rapid rate. Especially marked has been the increase in the hatchery product during the past ten years, owing in part to the establishment of new stations, in part to the extension of operations at existing stations, and in part to greater efficiency of methods and appliances. The work during the fiscal year 1909 reached larger proportions than ever before, over three

TESTING A LAND-LOCKED OR SEBAGO SALMON AT GRAND LAKE STREAM, MAINE, TO DETERMINE WHETHER ITS EGGS ARE RIPE

billion fish being produced and planted, as shown in the table:

Summary of Output, 1909

Species	Number
Salmons	164,648,170
Trouts	75,839,430
Whitefishes	419,665,000
Shad	57,378,000
Fresh-water basses	1,599,195
Pike perch	644,900,000
Yellow perch	223,661,285
White Perch	343,262,650
Cods	184,426,000
Flatfish	786,626,000
Other fishes	40,617,180
Lobster	164,509,000
Total	3,107,131,910

During the fiscal year 1910 another record will be made, and the output will exceed that of the previous year by several hundred million. A very significant point in connection with these figures is that had the government not engaged in this work about 95 per cent of the food-fish shown would never have existed at all, because they would have been sent to market in the form of eggs.

While the bureau does not lay undue stress on mere numbers and considers the vitality of the fish and the conditions under which they are planted as of paramount importance, the foregoing figures

are certainly very suggestive; and as a further statement of the magnitude of the fish-cultural work it may be of interest to record that the aggregate output of the hatcheries from 1872 to 1909 was about 28 billion, of which over 13 billion represents the work of the past six years.

HOW THE FISH ARE DISTRIBUTED

The first consideration in the distribution of fishes is to make ample return to the waters from which eggs or fish have been collected. The remainder of the product is consigned to suitable public or private waters.

All applications for fish for private waters and many of those for public streams and lakes are transmitted through and receive the indorsement of a United States Senator or Representative. The demand, especially for the basses, crappies, and catfishes, is greater than can be met with present resources.

The supply of particular fishes available for distribution, and consequently the number allotted to individual applicants or deposited in public waters, depends on differences in the methods of taking and hatching the eggs, on peculiarities of the young, and on the facilities for holding the latter at the stations. The area and character of the water to be stocked must likewise be considered.

The water area that would receive a million pike-perch fry would perhaps be assigned no more than 200 or 300 black bass 3 or 4 inches long, or four to eight times that many if the bass were planted as fry. The explanation is in the fact that pike perch can be propagated by the hundred million, while black bass, hatched by other methods or collected from overflowed lands, can be produced only in comparatively small numbers. The bureau does not attempt to assign any applicant more than a liberal brood stock of the basses or sunfishes. With brook trout, which are distributed both as fry and fingerlings, allotments of fry are many times larger than allotments of fingerlings 3 to 4 inches long.

Fishes are distributed at various stages of development, according to the species, the numbers in the hatcheries, and the facilities for rearing. The commercial fishes, hatched in lots of many millions, are necessarily planted as fry. It is customary to distribute them just before the umbilical sac is completely absorbed.

Atlantic salmon, land-locked salmon, and various species of trout, in such numbers as the hatchery facilities permit, are reared to fingerlings from 1 to 6 inches in length; the remainder are distributed as fry.

The basses and sunfishes are distributed from the fish-cultural stations and ponds from some three weeks after they are hatched until they are several months of age. When the last lots are shipped the basses usually range from 4 to 6 inches and the sunfishes from 2 to 4 inches in length. The numerous fishes collected in overflowed lands—basses, crappies, sunfishes, catfishes, yellow perch, and others—are 2 to 6 inches in length when taken and distributed.

Eggs are distributed only to State hatcheries or to applicants who have facilities.

SPECIAL CARS FOR THE FISH

Fish are delivered to applicants free of charge at the railroad station nearest the point of deposit, and for this purpose is maintained a special car and messenger service, which is one of the most important adjuncts of the fish-cultural work. In the early days baggage cars were employed, but these have now been supplanted by an equipment which not only affords more comfort to fish and attendants, but makes it possible to transport the fish much greater distances and with smaller percentage of loss.

The cars, of which there are now six, are of standard size and are attached to regular express and local passenger trains. Each car has 20 or more large water tanks along the sides in which to carry fish, compartments holding more than 1,000 gallons of reserve water, a boiler-room, and a plant for pumping both water and air into the fish tanks. There are also an office, kitchen, pantries, refrigerator, and six sleeping berths, with other facilities

TAGGING A PENOBSCOT SALMON

By means of metal tags attached to salmon, which are liberated after their eggs have been obtained, important information regarding the sea life of the New England salmon has been secured when the fish returned to the river to spawn. Similar experiments cannot be made with the Pacific salmon, as the latter fish die after once spawning (see pages 432 and 433).

for the convenience and comfort of the crew of five men (including a cook), who live on the car throughout the year. The government furnishes the cook, fuel, and utensils, but the men provide their own food.

For small shipments of fish and for supplying places off the main railway lines, messengers detached from the cars carry fish in 10-gallon cans in baggage cars. The distributions in 1908 required travel amounting to 83,840 miles by the bureau's 6 cars and 263,196 miles by detached messengers—a total of 347,036 miles—of which 11,826 for cars and 80,816 for messengers were furnished by the railroads free of charge.

POPULARITY OF THE WORK

There are few enterprises undertaken by the United States Government that are more popular, meet with more general and generous support, and have contributed more to the prosperity and hap-

INTERIOR OF A PACIFIC COAST SALMON HATCHERY

The salmon eggs are incubated in wire baskets arranged in double rows in long troughs
(see pages 421 and 432)

piness of a larger number of people than its fish-cultural work, an evidence of which fact is afforded by the attitude and action of Congress. The comparatively large budget for the various branches of the bureau's work is voted each year without any opposition whatever and the appropriations are increasing yearly. When special needs arise and their merit is presented to Congress, special appropriations can usually be obtained, and government fish-culture is so popular in the country at large and the demand for new hatcheries is so widespread that an extraordinary number of hatchery bills have been introduced and favorably considered in recent sessions of Congress.

The bureau advocates the building of new hatcheries as one of the best and most remunerative measures that can possibly be undertaken by the federal government, but it rarely has to take the initiative, and on several occasions the establishment of a hatchery has been proposed by Congress before the necessity for it has actually developed.

During each of the recent sessions of Congress, had all the bills providing for new hatcheries become laws, the bureau would have been seriously handicapped in designing and constructing the new buildings and ponds and in supplying competent persons to operate them. In the first session of the Sixtieth Congress there were introduced 101 distinct bills, carrying an aggregate appropriation of $2,142,000 and providing for 74 hatcheries and 4 laboratories in 43 States and Territories.

SCIENCE AND THE FISH SUPPLY

In making his original plans for the systematic investigation of the waters of the United States and the biological and

physical problems they present, Commissioner Baird insisted that to study only the food-fishes would be of little importance, and that useful conclusions must needs rest upon a broad foundation of investigations purely scientific in character. The life history of species of economic value should be understood from beginning to end, but no less requisite is it to know the histories of the animals and plants upon which they feed or upon which their food is nourished; the history of their enemies and friends and the friends and foes of their enemies and friends, as well as the currents, temperatures, and other physical phenomena of the waters in relation to migration, reproduction, and growth.

In pursuance of this policy the bureau has secured the services of many prominent men of science, and much of the progress in the artificial propagation of fishes, in the investigation of fishery problems, and in the extension of knowledge of our aquatic resources has been due to men eminent as zoölogists who have been associated with the work temporarily. Their services have been the services of specialists for particular problems, and through them the bureau has not only been able to give to the public the practical results of applied science, but has contributed to pure science valuable knowledge of all forms of aquatic life.

The small permanent staff of the bureau concerns itself more directly with studies of fishes and their environment, with the conservation of diminishing commercial species, and the development of new or improved methods of increasing the supply. Such lines of work are undertaken as the need appears or as assistance is asked for, and keep the scientific assistants in the field for extended periods each year. Some of the most important work in hand at present concerns aquatic products other than fishes, namely, oysters, fresh-water mussels, sponges, and the diamond-back terrapin, in all of which cases the problem is to find means to offset the results of long-continued overdraft upon the natural supply.

Two seaside laboratories are maintained by the bureau for the prosecution of investigations in pure and applied science. One of these is located at Woods Hole, Massachusetts. It was built in 1883, and is in conjunction with a marine fish hatchery. Here also are extensive wharves, at which the largest vessels may lie, and protected harbors for small craft. A large residence building at this station was for a number of years occupied as the summer headquarters of the bureau, the entire executive and office force being transferred from Washington.

The other laboratory is situated on a small island at Beaufort, North Carolina, and was constructed in 1901. The land for both of these stations was donated by private individuals. In addition to their function in the investigations of the bureau itself, these laboratories are open to the public for study and scientific research. Students and professors in colleges and any other qualified investigators may have the facilities of the laboratories upon request, and these opportunities are largely availed of each year.

CRUISES OF THE ALBATROSS

For the survey of off-shore fishing grounds, the study of pelagic fishes, and the general exploration of the seas, the bureau has had, since 1882, the *Albatross*, a twin-screw iron steamer, rigged as a brigantine, of 1,074 tons displacement, which was specially designed and built for this work and has contributed more to the knowledge of the life and physics of the sea than any other vessel. The complement of officers and men, numbering about 80, is furnished by the navy; there is in addition a small civilian staff, including a resident naturalist and a fishery expert, to whom the practical work of the ship is intrusted.

After spending several years in the investigation of the fishing grounds of the Atlantic coast of North America, the *Albatross* was dispatched to the Pacific Ocean in 1888 and has since confined her operations to those waters. The vessel has made three extended cruises to the

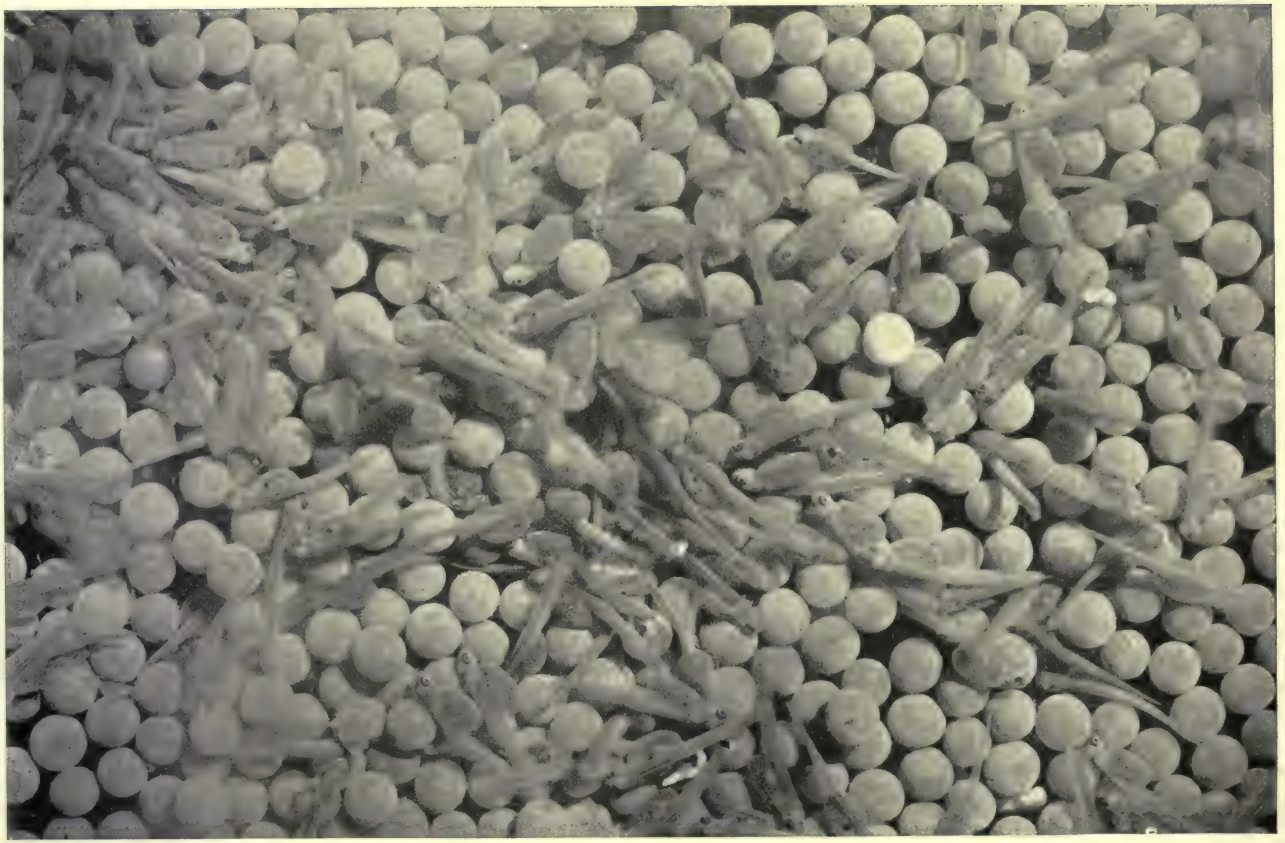
OPEN-AIR TROUGHS FOR REARING SALMON AT A HATCHERY ON THE PENOBSCOT RIVER IN MAINE (SEE PAGES 432 AND 433)

southern and eastern parts of the Pacific, several cruises to the Hawaiian Islands and Japan, and many visits to Alaska, in addition to numerous surveys on the coast of the Pacific States, all having for their object the investigation of the physics and biology of the regions visited, the determination of their aquatic resources, and the study of their fisheries. In 1907 the vessel began a survey of the waters of the Philippine Archipelago and has just completed that work.

The deepest sounding made by the *Albatross*—near the island of Guam—was 4,813 fathoms; the greatest depth at which the vessel found life was 4,173 fathoms; the greatest known ocean depth is 5,269 fathoms, near Guam, ascertained by the U. S. S. *Nero* while using *Albatross* apparatus.

WORK IN BEHALF OF THE COMMERCIAL FISHERIES

The first duty to which the Bureau of Fisheries was assigned, namely, the investigation of the reported decrease of food-fishes in New England, necessarily involved the collection of statistics of production, personnel, and capital. Since that time this branch of the work has been conducted without interruption, and in it have naturally been included the various other subjects affecting the economic and commercial aspects of the fisheries. Among the bureau's functions in this field are (1) a general survey of the commercial fisheries of the country; (2) a study of the fishery grounds with reference to their extent, resources, yield, and condition; (3) a study of the vessels and boats employed in the fisheries with special reference to their improvement; (4) a determination of the utility and effect of the apparatus of capture employed in each fishery; (5) a study of the methods of fishing, for the special purpose of suggesting improvements or of discovering the use of unprofitable or unnecessarily destructive methods; (6) an inquiry into the methods



EGGS AND NEWLY HATCHED FRY OF THE LAKE TROUT: NATURAL SIZE

The lake trout ranges from Maine to Alaska and is the largest and most valuable trout in the world. The fishing is most extensive in Lakes Michigan, Huron, and Superior (see page 432)

of utilizing fishery products, the means and methods of transportation, and the extent and condition of the wholesale trade; (7) a census of the fishing population, their economic and hygienic condition, nativity, and citizenship; (8) a study of international questions affecting the fisheries; (9) the prosecution of inquiries regarding the fishing apparatus and methods of foreign countries.

PROTECTING THE ALASKAN SALMON

The fishing interests of Alaska, representing an investment of $10,000,000 and yielding last year a product valued at more than $11,800,000, have received especial attention from the government ever since the territory was acquired, in 1867. The seal fisheries, at first considered the most valuable sources of revenue, were at once placed under protective legislation. Later there appeared a similar need of regulation of the salmon fisheries, which have now come to support industries many times more valuable than the seal fisheries and standing in large proportion to the total fishing interests of the whole United States.

The Alaska salmon-inspection service has thus grown to be one of the most important branches of government fishery work, and it is one of the few instances where the government has assumed legislative powers over fishing.

The protection of the Alaska salmon fisheries has been a difficult problem. The unheard-of magnitude of the resources invited a corresponding recklessness and improvidence. As the canning industry developed, every device that could be used for wholesale capture of fish was put into operation, and gradually all of the favorite streams of the salmon became so blocked with seines, gill nets, traps, and barricades that but a small proportion of the fish could find passage to the spawning grounds, and the future supply was thus most seriously endangered.

The Alaskan aborigines likewise conducted their fishing in a very destructive way, often placing impassable barriers in streams up which salmon were running, and, through ignorance or indifference, leaving the obstructions in place after the full supply of fish had been secured. It was soon apparent that the laws and regulations were inadequate to meet the special conditions prevailing, and were of such a nature as to make their enforcement very difficult.

In 1903 a special commission was appointed to make exhaustive study of the natural history of the salmons of Alaska and to submit recommendations for an improved regulation of the fisheries. As a result a new code of laws is now in effect and promises to prevent the threatened decline in these enormous industries. With increased restrictions as to fishing methods, obstructions in streams, close seasons, etc., the Department of Commerce and Labor is empowered to set aside any streams as spawning preserves whenever such course shall be desirable, all fishing in such waters to be prohibited. A license tax is required on all salmon products; from the payment of this tax, however, all canning and salting establishments are exempted upon condition of their returning young salmon to the streams in the ratio of 1,000 fry to every 10 cases of salmon canned. Five private hatcheries, representing extensive canning interests, were in operation in 1908 and liberated a total of 150,000,000 young fish.

The seal and salmon fisheries have hitherto overshadowed all other aquatic resources in Alaska, not only in commercial value but in revenue to the government. The rental from the fur-seal islands alone has more than repaid the purchase price of the territory, and the tax derived from the salmon fisheries now amounts to about $100,000 a year. Some long-neglected products are gradually coming into importance, however, and the cod, halibut, and herring fisheries especially have undergone remarkable development in the last few years. Since it became a part of the United States, Alaska has yielded fishery products amounting in value to $170,000,000, of which about $50,000,000 was derived from fur-seals, $96,000,000 from salmon,

and the remaining $24,000,000 from all other aquatic products.

THREE BILLION SHAD HAVE BEEN PLANTED

Much evidence can be adduced to show that the fish-cultural operations of the general government are of direct financial benefit to the country at large. The results in the case of some species have been so striking and so widespread that it would be almost as supererogatory to refer to them as to discuss the utility of agriculture; in the case of other species there can be no doubt of the value of the work, although it may be possible only occasionally to distinguish the effects of human intervention on the fish supply from the effects of natural causes. The outcome of the bureau's efforts to increase the food supply is naturally most evident in the case of small streams, lakes, and ponds, of which thousands have been successfully stocked with the most desirable food and game species.

The leading river fish of the eastern seaboard is the shad. No other anadromous species has been more extensively cultivated and none is now so dependent on artificial measures for its perpetuation. Inasmuch as the principal fisheries are in interstate or coastal waters and the movements of the fish from the high seas to our rivers and back to the high seas place it beyond the claim to ownership which might be urged by the various states were the shad a permanent resident within their jurisdiction, it seemed especially desirable and necessary that this species should be fostered by the general government for the benefit of the entire country. For this reason, and owing to a serious decline that had already set in, the shad was one of the first species whose artificial propagation was taken up by the bureau, and its cultivation is today a leading factor in fishery work, almost every large stream having been the site of hatching operations.

The extent of the work may be gaged when it is stated that nearly 3,000 millions of young shad have been planted by the bureau in coastal streams; and a very significant point is that the eggs from which these fish were hatched were taken from fish that had been caught for market, and hence would have been totally lost if the bureau had not collected them from the fishermen.

EXTINCTION OF SHAD IS THREATENED

The great multiplication of all kinds of fishing appliances on the coast, in the bays, in the estuaries, and along the courses of the rivers resulted in the capture of a very large part of the run each season before the shad reached the spawning grounds, and hence the natural increase was seriously curtailed, and in some streams almost entirely prevented. Yet the shad catch increased, and for many years the fishery prospered in the face of conditions more unfavorable than confront any other fish of our eastern rivers.

At length, however, the unrestricted fishing became greedy to an overwhelming extent. The mouths of the rivers and the lower waters through which the shad must pass became so choked with nets that fishing gear farther upstream could make but slender hauls; and for several years there has been a steady decline in catch, which threatens to result in the extinction of the fishery. The bureau has continued its efforts in propagation, but these are curtailed by the factor that is also destructive to the fishery.

When they first enter the streams the shad are not ripe and are useless to the hatcheries, and the spawn-takers must therefore wait for the run farther upstream; but with the recent exhaustive fishing in the salt waters so few fish have escaped that the egg collections have diminished to an alarming extent, being reckoned now in millions where formerly they were hundreds of millions.

Under such conditions it is impossible to propagate enough fish to offset the quantities taken, and the shad fishery is fast being deprived of its one support, while the present meager shad catch, together with the enforced curtailment of propagation, speaks even more convinc-

ARTIFICIAL PROPAGATION OF THE WHITEFISH ON THE DETROIT RIVER

Mature fish, destined for the market, are retained in live-cars and regularly overhauled as their eggs are ripening. After being artificially fertilized, the eggs are sent to the hatchery. This work is very extensive and important, and hundreds of million young whitefish are produced on the Great Lakes each year that would be entirely non-existent except for the government's efforts (see pages 422 and 432).

CATCHING AND SORTING THE BROOD-FISH AT A TROUT-CULTURAL STATION IN THE ROCKY MOUNTAINS

ingly of the value of artificial measures than did the preceding increase.

WORK ON THE GREAT LAKES

Evidence is not lacking to show that the long-continued and increasingly extensive fish-cultural operations on the Great Lakes have prevented the depletion of those waters in the face of the most exhausting lake fisheries in the world.

The luscious whitefish, the splendid lake trout, the excellent pike perch, or wall-eyed pike, may be hatched in such numbers as to assure their preservation without serious curtailment of the fisheries. The absence of concerted protective measures, however, on the part of the various states interested has the tendency to minimize the effects of cultivation and would seem to justify, if not imperatively demand, the assumption of jurisdiction by the federal government.

1,700 BUSHELS OF SALMON EGGS DISTRIBUTED IN ONE YEAR

The long continuance of the Penobscot as a salmon stream for many years after all other New England rivers had ceased to carry this fish is directly attributable to the work of the bureau on that stream. So dependent on artificial measures has been the perpetuation of the salmon supply that it is believed the obliteration of the run and the wiping out of a long-established fishery would ensue within five years after the suspension of fish-cultural operations. Physical conditions in the Penobscot have become so unfavorable for the passage of salmon to the spawning grounds that natural reproduction is now almost if not altogether inhibited, and the only noteworthy source of young salmon is the eggs obtained by the bureau from salmon purchased from the fishermen.

The magnitude of the salmon fisheries of the Pacific States has required very

A GOVERNMENT SPAWN-TAKER OVERHAULING THE COD CATCH OF A NEW ENGLAND SCHOONER AND TAKING THE RIPE EGGS (SEE PAGE 435)

extensive artificial measures to keep up the supply. The operations of the bureau, in combination with those of the states, have been gradually extended in both scale and scope until they have now attained a tremendous extent and are addressed to all the species whose cultivation is as yet demanded. The number of Pacific salmon eggs collected by the bureau in 1908 was over 200,000,000, equivalent to 1,700 bushels.

A remarkable fact in the history of the Pacific salmons, of which there are five species, is that without exception all fish which enter any stream on the entire coast die after once spawning, none surviving to return to the sea.

This wise provision of nature to prevent the overstocking of streams has been made foolish by the appearance of man on the scene; he not only catches the salmon in the coast rivers and the lower courses of the rivers will gill nets, seines, and pound nets, in the upper waters with the same appliances supplemented by the fish wheels, and on the spawning grounds with all sorts of contrivances, but in certain sections even carries his foolhardy greed to the extent of barricading the streams so that no fish can reach the waters where their eggs must be deposited.

Natural reproduction, thus so seriously curtailed, is not sufficient to keep up the supply in many of the streams where fishing is most active, for many of the eggs escape fertilization, many more are eaten by the swarms of predaceous fishes that haunt the spawning beds, and many are lost in various other ways during the long hatching period; while the helpless fry and alevins fall a ready prey

FEEDING RAINBOW TROUT IN AN ARTIFICIAL SPAWNING POND AND RACEWAY AT A VIRGINIA STATION

to the same fishes in the upper waters, and the young salmon have to run the long gauntlet of the rivers only to meet new foes in the estuaries, on the coast, and in the open sea.

It is, therefore, no wonder that artificial propagation on a large scale is imperatively demanded in the western salmon streams, and is actively urged and highly commended by fishermen, canners, business men, and the public at large.

The history of the salmon fishery in the Sacramento River, in California, and the recent increase in the catch notwithstanding most unfavorable physical conditions in that stream, afford unmistakable evidence of the value of cultivation.

Some very suggestive, though not altogether conclusive, information relative to the benefits of salmon culture in the Columbia River has been furnished by marking young salmon before releasing them from the hatcheries. The number of marked salmon that returned as mature fish and were captured and reported indicates a very large percentage of survivals and suggests the growing dependence on artificial propagation for the maintenance of the runs.

NEW ENGLAND COD AND LOBSTERS CONSERVED

In the case of marine hatching operations it is so difficult to prove beneficial results that their utility is doubted by some people. When the bureau began

the cultivation of the cod and the lobster many years ago, it proceeded on the principle that the effects of the fishermen's improvidence could be counteracted by artificial propagation. The ultimate success of cod and lobster culture on the Atlantic coast was therefore confidently expected, and the expectations have been more than realized. Practical results of an unmistakable character were first manifested nearly twenty years ago, since which time a very lucrative shore cod fishery has been kept up on grounds that were entirely depleted or that had never contained cod in noteworthy numbers in the memory of the oldest inhabitants.

There is much unsolicited testimony on this point from many people who have profited from the operations of the Maine and Massachusetts stations. The benefits have not been confined to the immediate vicinity of the hatcheries, but have extended westward and southward along the Middle Atlantic coast and eastward along the whole coast of Maine.

The benefits of lobster culture have been slower in appearing, owing, in part at least, to the less extensive operations and the excessive mortality to which the young are liable; but from all parts of the New England coast there are being received reports of more lobsters, particularly of small size, than have been seen for many years, and there is reason to believe that the long-continued decline of the lobster fishery may have been arrested.

PROFITABLE FISH IMPORTED FROM EUROPE

Economic results of great value have come from the transplanting of native aquatic animals into waters in which they are not indigenous and from the introduction of fishes of foreign countries into the United States. The supply of food and game fishes of every section of the country has thus been increased and enriched, fisheries of vast extent have been established, and the pleasures of angling have been greatly enhanced.

As this phase of the work has recently been set forth in detail,* it need not be dwelt on here, and it will be sufficient to note that the acclimatized fishes taken and sold in this country now have a value of fully two million dollars a year. Much more important results, however, are seen in the tremendous quantities of such fish annually caught by anglers and for home consumption, whose money value cannot be reckoned. The aggregate results of acclimatization up to the present time, so far as fish caught and sold are concerned, represent at least twenty million dollars to the fishermen and a fifty-fold return on the government's investment.

By far the most important of the exotic fishes is the German carp, of which in 1908 nearly forty-three million pounds were caught in public waters by professional fishermen, and sold for over a million dollars. These fish were the progeny of carp imported by the bureau many years ago and presented in small lots to farmers and others in all parts of the country for the stocking of private ponds and reservoirs. By the overflowing of these waters or the breaking of dams, streams and lakes have become planted with the carp, which is now the most widely distributed fish in the United States.

HELPING THE SHAD FISHERIES OF NORTH CAROLINA

The long-continued and systematic field and laboratory work of the bureau has resulted in a most thorough knowledge of the distribution, abundance, habits, etc., of the fishes and other creatures of the interior, coastwise, and offshore waters of the United States, Hawaii, and Porto Rico—a knowledge which is indispensable to the government in its fish-cultural work and to the various states and insular authorities in their legislative efforts to preserve their fishery resources. The practical results of this work are apparent in numerous specific instances.

*Our Fish Immigrants: The Acclimatization of Native and Foreign Water Animals in the United States. By Hugh M. Smith. NATIONAL GEOGRAPHIC MAGAZINE, June, 1907.

STRIPPING TROUT OF THEIR EGGS AT A STATION OF THE BUREAU OF FISHERIES IN THE ROCKY MOUNTAINS
(SEE PAGES 418-419)

"It is conceived to be the better policy to expend a small amount of public money in making fish so abundant that they can be caught without restriction and serve as cheap food for the people at large, rather than to expend a much larger sum in preventing the people from catching the few fish that still remain after generations of improvidence."

TRIAL FISHING ON THE "ALBATROSS"

While surveying a new "bank" on the coast of Alaska, this experimental catch of cod and halibut was made in 20 minutes. As a result of explorations of the *Albatross* on the Pacific coast, fisheries of great importance have been established, and the Pacific halibut fishery now surpasses that in the Atlantic (see page 426).

Upon two subjects in particular has the bureau expended much energy and at last achieved results by persistently sounding the note of warning. The utmost efforts in artificial propagation cannot save the shad fishery without the aid of laws to permit a certain number of spawning fish to reach the streams, while on the other hand no practicable protective laws can save the oyster supply without cultural work to keep up the beds. The bureau has no power to do more than hatch fish in the one case, devise methods of culture in the other, and cry out the needs of both, and it lies solely with the states to provide for the needs.

North Carolina rose to the emergency of the shad situation a few years ago and sought the aid of the bureau in determining the actual protection required by the shad, the actual condition of the fishery, and the possible remedies for a rapidly diminishing yield. The bureau's recommendations were asked for by the state legislature, and a commission was appointed to draft salutary laws, which have since gone into effect, confining gear to prescribed areas and leaving clear channels for the passage of the fish.

REMOVING SHAD EGGS AT A STATION IN NORTH CAROLINA

Nearly 3,000 millions of young shad have been planted by the Bureau of Fisheries in coastal streams. All the eggs from which these fish were hatched were taken from fish that had been caught for market, and hence would have been totally lost if the bureau had not collected them from the fishermen (see pages 430 and 435).

Immediate results have been seen at the government hatchery in the Albemarle Sound region. The collection of shad eggs in these waters in five years had dropped from 75 million to 6½ million. The next year, which was the first of enforcement of the new laws, the collection was 25½ million, and in 1908 and 1909 the most successful shad hatchery was in this State, the egg collections exceeding 55 million and 60 million, respectively.

RESCUING THE MARYLAND OYSTER BEDS FROM EXTINCTION

The oyster fishery has had a common history in all of the Southern States, of

SPECIMEN OF ROCK BOTTOM ON WHICH SPONGES GROW, FROM THE SPONGE BEDS OFF ANCLOTE KEY, FLORIDA

This rock bears 13 species of commercial and non-commercial sponges, besides corals, sea-feathers, starfishes, crabs, and other animals characteristic of the fauna of the sponge beds. One-eighth natural size.

which Maryland, once the foremost in oyster production and one of the last to resort to systematic cultural measures, affords the most notable example. The laws controlling the fishery in Chesapeake Bay have been designed to protect the natural beds, but have not encouraged or protected the oyster planter, and the natural beds, thus practically the sole reliance, in time failed to sustain the tremendous draft upon them. Between 1880 and 1897 the product fell 31.6 per cent; in 1904 it was 39 per cent less than in 1897.

The bureau had for many years pointed out the short-sighted policy that was resulting in the steady decline of the oyster industry, and was at length gratified to find that the state had taken heed of the warning and enacted a comprehensive law favoring oyster planting. The work that has now been undertaken by the Maryland Shell Fish Commission to remedy the alarming condition of the oyster grounds will be the most complete and accurate of its kind. It consists of the survey and delimitation, by the aid of the United States Coast and Geodetic Survey and the Bureau of Fisheries, of all natural oyster beds in Maryland waters, to be marked and set aside as public fishing grounds operated under the

SPONGE CUTTINGS VARIOUSLY MOUNTED ON CEMENT DISKS AND READY FOR PLANTING

existing protective laws. All other suitable grounds will then be reserved by the state to be leased to oyster planters, whose enterprise will be encouraged and their rights protected as was not possible heretofore.

OYSTERS IN LOUISIANA AND SPONGES IN FLORIDA

Up to 1898 there were few planted beds of oysters in Louisiana waters. Investigation of the oyster grounds by the bureau in that year, however, led to the passage of beneficial laws and proved a general stimulus to oyster culture in that state, as is shown by the fact that some 20,000 acres of bottom were soon under cultivation. In 1906 the state oyster commission again asked the bureau's assistance, and large areas of utilized bottom were examined to determine their productive capacity. The conditions were found to be exceptionally favorable, and experimental plants produced 3½ to 4 inch oysters in quantities of 1,000 to 2,000 bushels per acre, within two years after the cultch was put down.

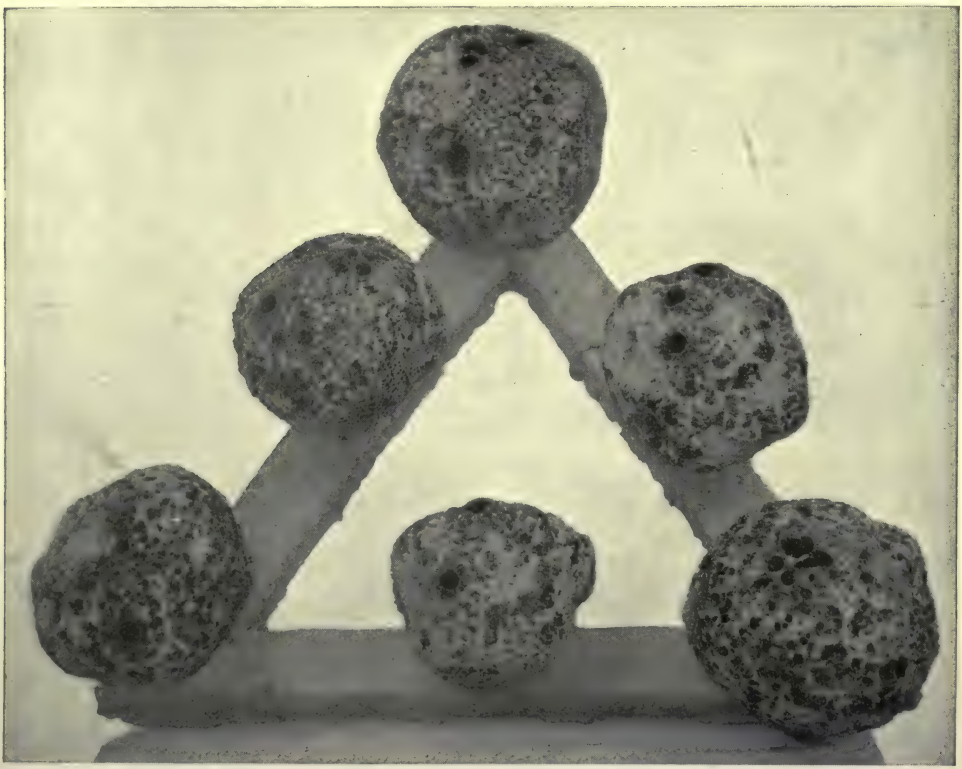
In Barataria Bay, where there had been no oysters whatever, such promising beds were established that several hundred acres of adjacent bottom were immediately leased by prospective planters. Other localities, though they have so far shown no such conspicuous commercial enterprise, may be expected to prove equally productive.

Experiments in sponge culture have been in progress for several years, and have now developed a practical system by which sponges may be produced from cuttings at a cost much less than that entailed in taking them from the natural beds. In view of the more rapid depletion of the natural beds which will undoubtedly result from recent changes in the methods of the fishery, the bureau is convinced that the preservation of the American sponge industry will depend upon cultivation; and as it is estimated that about $1,500,000 worth of sponges were taken in Florida during the past year, the failure of the fishery would be a serious commercial loss to the state.

MUSSELS FOR PEARL BUTTONS

In coöperation with the Rhode Island Fish Commission, the bureau has developed new methods of lobster and soft-shell clam culture which are being applied with success in New England. Experiments with the hard-shell clam are now in progress at Beaufort.

Important work recently undertaken is an effort to establish mussel culture in the Mississippi Valley. The supply of mussels in those waters, on which is based a pearl-button industry valued at about $5,000,000 per annum, with an investment of $6,000,000, is being rapidly exhausted, and the mussel fishermen and manufacturers recognize that without scientific coöperation of the government



SPONGES, PLANTED FROM CUTTINGS AND GROWING ON CEMENT DISKS
(SEE PAGE 440)

SHEEPSWOOL SPONGE, 35 MONTHS OLD

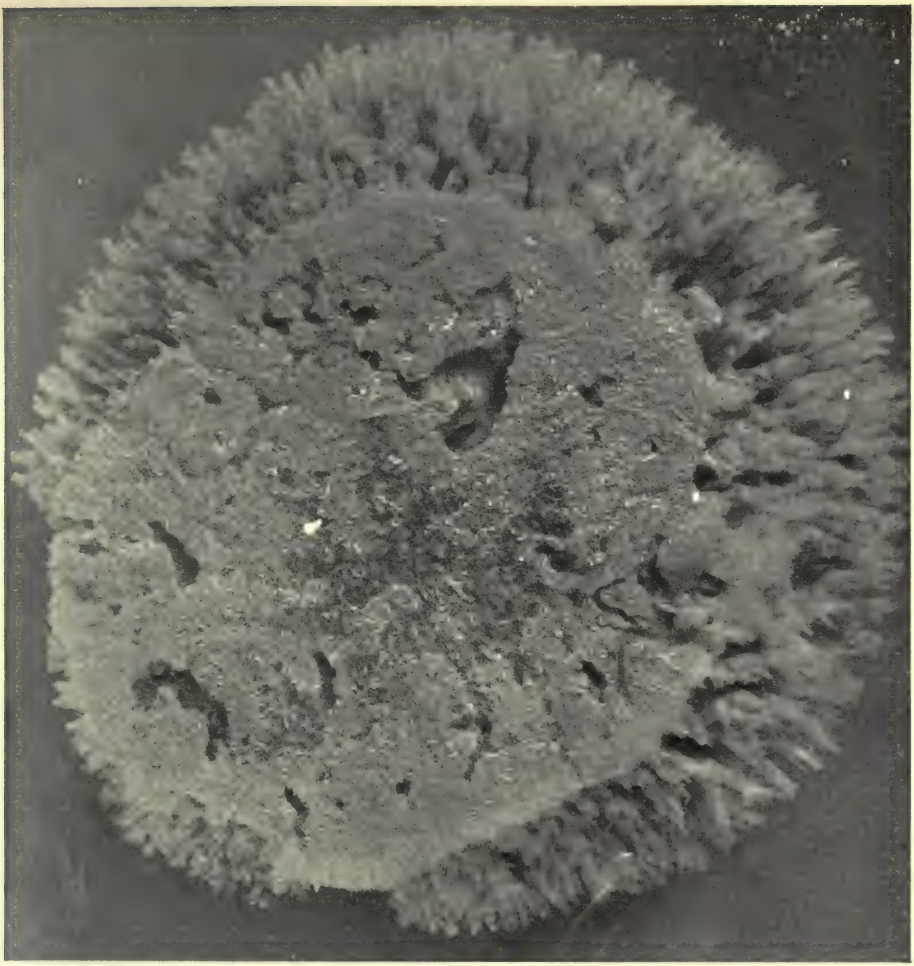
Grown on spindles in Cape Florida Channel from a cutting. Weight, dry and thoroughly cleaned, 1 1/3 ounces. Three-fourths natural size (see page 440)

the business is doomed to early extinction.

The bureau in one season's work has practically, though not conclusively, shown a method by which the pearl mussels can be propagated, and is demonstrating that the work can be carried on at a comparatively small expense in connection with the already established operations in rescuing fishes from the overflowed lands, the fish reclaimed being employed, without injury to themselves, in the dissemination of the larvæ of the mussels.

There have been liberated 25,000 fish, bearing about 25,000,000 young mussels ready to drop and begin their independent existence and already past the stage when they are most subject to fatality.

The work is also capable of application to waters under private control and will probably become a source of respectable revenue to farmers and others whose property embraces streams, ponds, and



THE UNDER SURFACE OF A SHEEPSWOOL SPONGE

Not over 18 months old; grown on a cement disk at Anclote Key from a cutting. Weight, dry and thoroughly cleaned, 1½ ounces. The root or under surface of natural sponges which grow on rough rock bottoms, as on page 439, and which must be torn from the rock, is raw, like the interior of the sponge, and therefore is the weakest and least durable part of the sponge. The root of cultivated sponges, on the contrary, is the strongest part of the sponge, as contact with the flat cement disk on which the cutting is planted develops a close and soft felt, as shown in this illustration.

lakes. The importance of this work is urgently insisted upon by the National Pearl Button Manufacturers' Association, which embraces practically the entire capital invested in the business.

STUDY OF DISEASES OF THE FISH

In the field of fish diseases great progress has been made in the extension of knowledge of the causes of many of the fatalities which sometimes make a clean sweep of the hatcheries and which heretofore could not be adequately coped with because their etiology was not understood. The services of the scientific staff in this regard have been not only of great benefit to the government, but are highly regarded and frequently availed of by state and private fish-culturists.

Among the direct material aids rendered

A CATCH OF LARGE, FAT HADDOCK IN THE NORTH SEA

By sending its experts to all parts of the world, the government has secured valuable new fish for the country and useful methods for the fishermen. Government fish-culture in America exceeds in extent and importance that of all other countries combined (see pages 429 and 435).

to fish-culture in the past four or five years are the following: (1) Determination of the cause and remedy for the fatal malady known as the "gas disease"; (2) isolation of a bacterial organism producing a fatal disease in trout and discovery of a possible remedy; (3) determination of the cause of a fatal protozoan disease in trout; (4) discovery of a remedy for the diatom disease of lobster eggs and larvæ; (5) studies of the causes for the death of fish in captivity and the determination of a number of cases of responsible peculiarities in the water supply; (6) studies of the character of streams and the effects of various conditions on fishes, which have supplied much information on the subject to the public; (7) determination of the effects on fishes of galvanized iron and other metallic containers used in transportation of fish and fry, and (8) indication of certain undesirable types of vessels for holding fish.

CANCER IN FISHES AND MAN

One of the recent developments in the study of fish pathology has been the discovery of a widely prevalent cancerous affection of the thyroid gland in trout and salmon under domestication. At certain hatcheries the disease attacks a very large percentage of the fish, many of which succumb in a short time.

While it is not believed that fish cancer may be communicated to human beings through the eating of infected fish, the conditions are serious as regards the hatchery work; for, unless the progress of the disease is arrested and preventive measures are discovered, artificial propagation will become inadequate to meet the present growing needs for fish for stocking purposes.

In the opinion of experts, cancer in fishes, while important in itself, is of very great and far-reaching consequence because of its bearing on the cause of cancer in man, and the vast amount of material thus made available for experiment and investigation throughout the country is thought to afford the best possible opportunity for the elucidation of general cancer problems.

President Taft was doubtless prompted by these considerations to send to Congress a special message in which he advocated an appropriation of $50,000 to enable the Bureau of Fisheries to establish a laboratory for the study of cancer in fishes.

NEW FISHERIES AND NEW METHODS DISCOVERED BY THE FEDERAL GOVERNMENT

The importance to the fishing interests of the work of the bureau in connection with the economic fisheries is widely appreciated and freely acknowledged. The statistical inquiries of the bureau afford the only adequate basis for determining the condition and trend of the fisheries and the results of legislation, protection, and cultivation. Among the numerous special matters in which the bureau has benefited the fisheries the following may be mentioned:

By bringing to the attention of American fishermen new methods and new apparatus, new fisheries have sometimes been established and new fields exploited.

By the introduction of cod gill nets the winter cod fishery of New England was revolutionized. In a single season shortly after the use of such nets began a few Cape Ann (Gloucester) fishermen took by this means over 8,000,000 pounds of large-sized fish, and as much as $50,000 has sometimes been saved annually in the single item of bait.

By the dissemination of information regarding new fishing grounds important fisheries have been inaugurated. Thus when the abundance of halibut off the coast of Iceland was made known by the bureau, a fishery was begun which yielded from $70,000 to $100,000 annually to the New England fishermen.

The bureau has experimented with various unused or little-used products in order to determine their economic value and to suggest the best ways of utilizing them. Less than fifteen years ago there was practically no market for the silver hake or whiting (*Merlucius bilinearis*), and immense quantities incidentally taken in pound nets and other apparatus were thrown away. The bureau pointed out

the possibility of preparing a marketable salt whiting, and it is a significant fact that in a few years the sales of this fish in New England have increased from about 100,000 pounds to 5,000,000 pounds.

LOSS OF LIFE FROM STORMS DIMINISHED BY A NEW TYPE OF FISHING VESSEL

Owing to the appalling mortality among the crews of the New England fishing vessels, caused in large part by the foundering of vessels at sea, the bureau many years ago undertook the introduction into the offshore fisheries of a type of craft which would combine large carrying capacity and great speed with enhanced safety. By correspondence, discussion in the daily press, personal interviews, exhibition of models, and finally by the actual construction of a full-sized schooner (the *Grampus*) with the requisite qualities, the bureau was enabled to inaugurate a momentous change in the architecture of fishing vessels; so that for a long time the New England schooners have been constructed on the new lines, with a consequent minimizing of disasters and a decided increase in efficiency.

For other fisheries and regions the bureau has likewise advocated improved types of vessels and boats especially adapted to local conditions, and has published plans and specifications embodying the results of studies of the fishing flotilla of the world.

The results of the bureau's efforts in this line, in saving life and property, in increasing the usefulness of the vessels, and in improving the quality of the catch as landed, cannot be estimated, but the beneficial effects may be partly appreciated when it is stated that during the ten years ending in 1883, when the old types of vessels were in use, there were lost by foundering from the port of Gloucester alone 82 vessels, valued at more than $400,000, with their crews of 895 men, while during the ten years ending in 1907 the losses from this cause aggregated only a fourth as many vessels and men.

OUR COAL LANDS

By Guy Elliott Mitchell

WHAT can the study of fossil shell-fish and ferns have to do with the price of coal? The connection is a closer one than may be supposed, and its explanation shows the intensely practical work of the government geologists in the application of abstruse science to every-day economy.

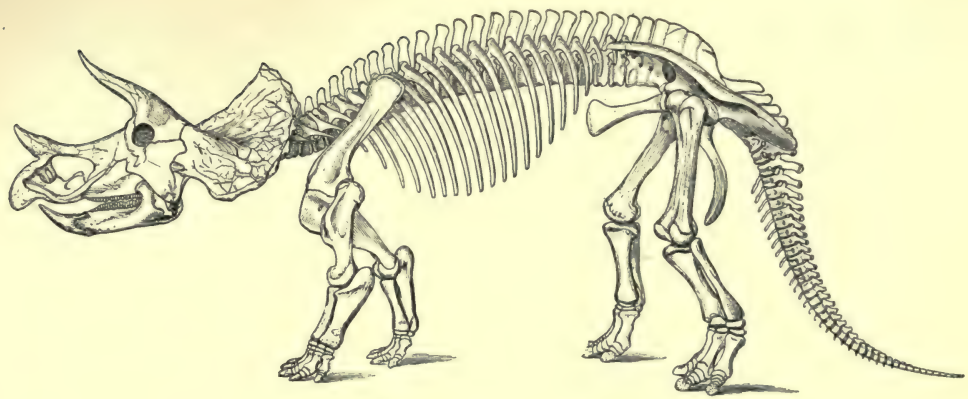
Paleontology is that branch of geology which deals with fossils as they are found in the different rock strata. Their presence easily determines the age of many rock formations which might not otherwise be recognized.

For instance, a certain species of conch may be known to have flourished during the Cretaceous period—too long ago to be estimated in years. During this period vast coal-beds were formed in the western and northwestern part of the United States as a result of the growth of a luxuriant and almost tropical vegetation.

Now here is a most valuable key for the coal geologist. In whatever strata of rocks he finds this fossil conch-shell and its associates he may look for coal of Cretaceous age.

It is due to the previous study of the broad stratigraphic and paleontological problems of the West that Uncle Sam's economic geologists have been able to classify between 35,000,000 and 40,000,000 acres of western coal lands within the short period of 4 years since President Roosevelt withdrew from entry all the government coal lands pending such classification and adequate valuation.

The particular kind of shell shown in the illustration has been of enormous importance in this classification work.



HE POINTS TO COAL

The huge *Triceratops* of the Wyoming Basin, 25 feet long by 10 feet tall, is, where found, a good lead for the coal geologist. His remains, however, are too scarce to be depended upon.

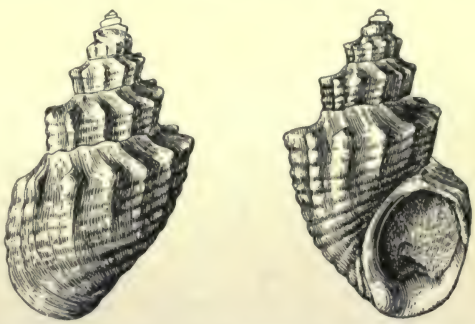
Where the coal geologist finds this conch in a rock formation he knows that no coal beds will be found lower down in the ground. He knows that some coal may be found in the same strata in which the conch lies, but that in the strata immediately above very high-grade coal can be confidently expected. The name of this little helper of Uncle Sam, who was a very abundant resident of the early United States, is *Pyrgulifera humerosa*. He hasn't any American name.

In this coal classification and valuation work, which is the next economic step following the discovery of the coal beds, the geologist comes down out of the realm of high science, with its Pyrguliferas and other things, right into camp with the every-day coal miner and operator. Using the data which the geologists bring in from each field season's work in Wyoming, Montana, Utah, and all the other public coal-land States, the Geological Survey at Washington works out the tonnage on every 40-acre tract of coal land, and, taking into consideration the quality and depth of the coal, places a valuation upon the land.

This valuation ranges all the way from $10 an acre up to several hundred dollars. Some of the land, where the coal seams are very thick, of high-grade coal, or where there are several seams, one over another, has been rated at over $400 an acre.

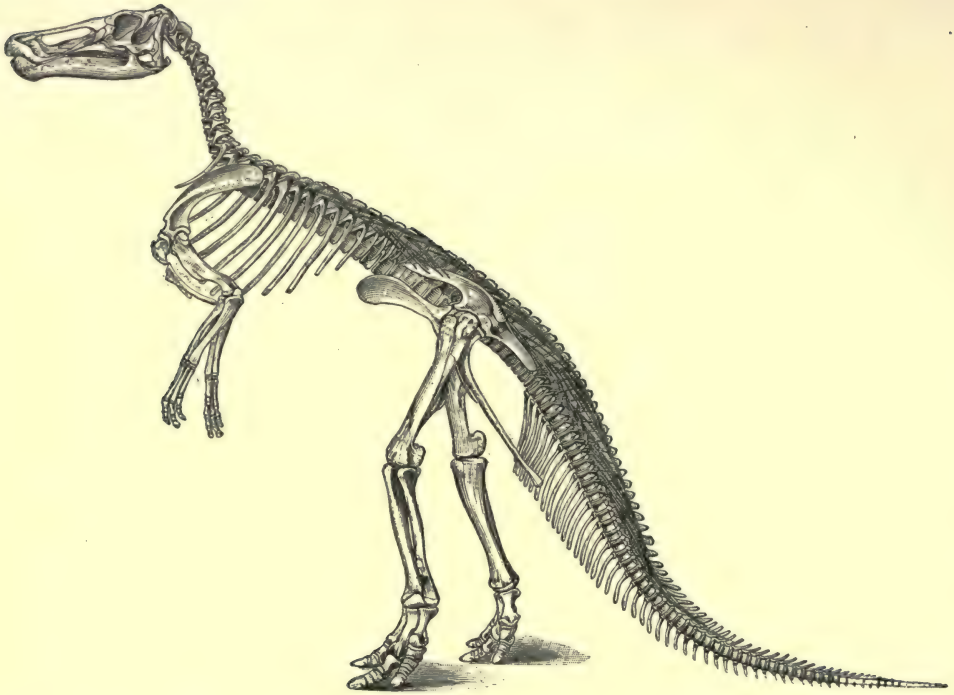
This seems like a big price—$64,000 for a 160-acre tract of coal land which, until the coal-land classification work began, in 1906, was sold at $20 an acre, or $3,200—but, when it is seen what a great amount of coal an acre of such land contains, even the $400 valuation looks small.

Many of the western coal lands are underlain by beds of 40, 50, and even aggregating 100 or more feet of solid coal. An acre of coal 40 feet thick contains 72,000 tons, and the Geological Survey calculates that at least 40,000 tons



FOSSIL SHELL OF A SMALL CRETACEOUS CONCH, PYRGULIFERA HUMEROSA

A most useful geologic key to the western coal beds



ANOTHER SPECTACULAR BUT NOT VERY DEPENDABLE GUIDE TO THE COAL GEOLOGIST: THE GIANT 30-FOOT CLAOSAURUS

He is too infrequent to be counted upon; whereas the little Conch, *Pyrgulifera*, is omnipresent just below the coal formation

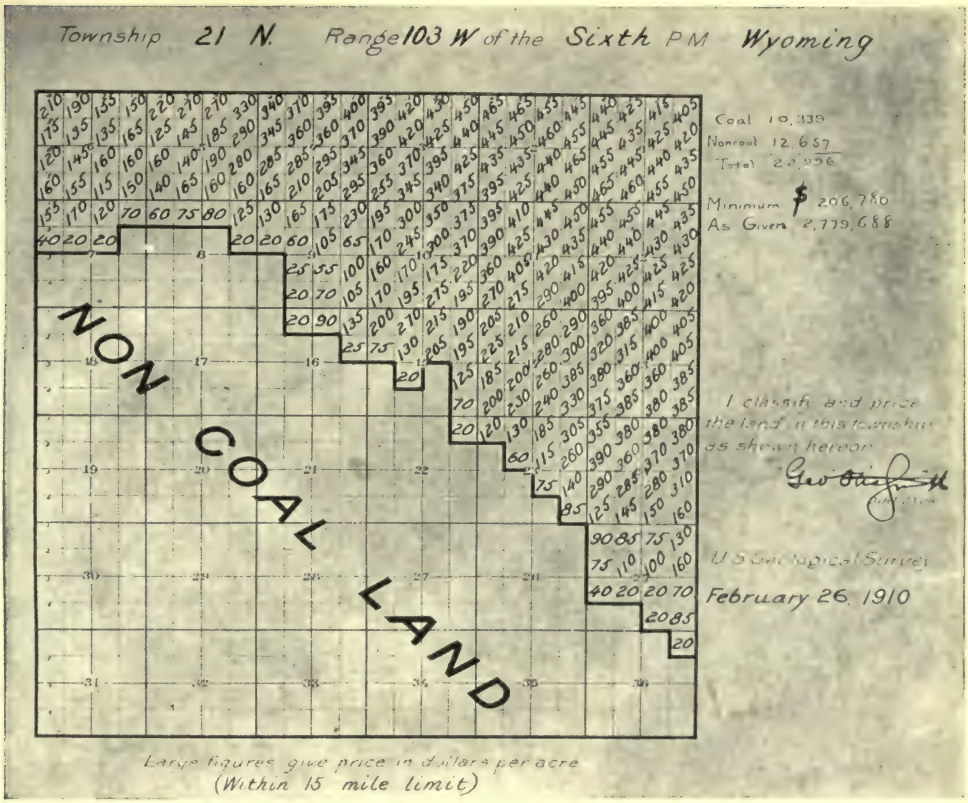
of this can be brought to the surface, thus making the very liberal allowance of almost half for loss in mining. Four hundred dollars an acre for such land would thus be a charge of only 1 cent a ton, certainly not much of a burden on the coal operator or the ultimate consumer.

Under Uncle Sam's new classification and valuation scheme, the public coal lands are now handled in a thoroughly business-like manner, and in sharp contrast with the old happy-go-lucky methods under which coal land was sold at a fixed and very low price, without regard to its real value, or even disposed of under agricultural or other laws at a nominal rate.

The coal-land law provides that coal land shall be sold at not less than $20 an acre if lying within 15 miles of a railroad, or $10 an acre if beyond that limit. Until 1907 this price had been regarded as the only price, but it was then decided that the figures named were clearly *minimum*. Since then the coal lands have been classified and valued by the Geological Survey at approximations of their commercial worth. During 1907-1908 valuations were fixed as high as $75 an acre.

In April, 1909, the Department of the Interior inaugurated a valuation plan based on the estimated tonnage of the coal deposits.

Since coal occurs in beds or seams, it is a comparatively easy matter in most instances for the geologists to estimate the tonnage with a fair degree of accuracy. An acre of coal one foot in depth contains approximately 1,800 tons, and 1,000 tons is allowed by the Survey as recoverable. The valuation regulations take into account thickness of beds, depth, whether


Township 21 N. Range 103 W of the Sixth PM Wyoming
NON COAL LAND
Coal 10,339
Noncoal 12,657
Total 23,996
Minimum $ 206,780
As Given 2,779,688
I classify and price the land in this township as shown hereon
U S Geological Survey
February 26, 1910
Large figures give price in dollars per acre
(Within 15 mile limit)

A WYOMING TOWNSHIP PARTIALLY UNDERLAIN BY COAL, CLASSIFIED AND VALUED IN 40-ACRE BLOCKS

Price ranges from $20 an acre to $465 an acre. Acreage of coal land in this township, 10,339 acres, valued at $2,779,688; avearge $268 per acre

one or more beds, and quality of coal. Under these regulations a maximum valuation of $300 an acre is allowed for virgin fields where the tonnage estimates are based solely on geologic conclusions, while in fields where mines are already developed and the prospective purchaser knows exactly what he will get there is no limit to the values which may be fixed.

Under these new regulations the area classified as coal land by the Geological Survey up to May 1, 1910, a period of 13 months, has been valued and the sale price fixed at $232,398,000—an average rate of a little over $52 an acre. This acreage would, if sold at the minimum price fixed by law, yield but $76,169,000.

Here is a gain, therefore, of $156,000,000 in coal-land values representing a little over a year of coal classification work.

The values of the coal lands, as fixed by the Survey, of course vary greatly; they run all the way from the minimum price up to as high as $465 an acre in certain lands in Wyoming. Each 40-acre tract is separately classified and valued.

In one Wyoming township, a plat of which is shown on this page, the value of the land classed as coal under the present regulations is $2,779,688. At the minimum price it would bring only $206,780.

During the single month of April ap-

A 30-FOOT COAL SEAM AT HANNA, WYOMING

A new coal field has recently been discovered in Arizona which probably contains more coal than has been mined to date from all the coal mines in the United States (see page 451)

proximately 350,000 acres of coal land were valued at $22,000,000, which is three times the value of the same area at the minimum price. At the present writing, May 24, the coal valuations for May, 1910, have already run $36,000,000.

The question may be asked whether, with 30,000,000 or 40,000,000 acres of coal land in the West now in private ownership, there will ever be a demand for these government coal lands at $200 or $400 or possibly a much higher figure per acre. The answer is that the lands are actually being purchased, and, moreover, these prices are very conservative.

The big coal companies themselves, such as the Union Pacific and the Rocky Mountain Coal Company, are today leasing coal lands from other parties and working them on a 10-cents-a-ton royalty basis, and thus actually paying in royalties several times what the government would charge the entryman as a cash price for similar coal lands.

At the Salt Lake City land office alone, during a single month, $200,000 worth of coal-land sales were made and 50 declaratory statements filed for purchase of additional coal tracts, aggregating probably another $200,000, or a total for a month's coal business in one land office of $400,000.

The government coal classification work has not yet been nearly enough completed to allow for even an estimate at what the total valuation figures will be, but a little rough guessing may prove of interest.

It is estimated by the Survey that there are approximately 50,000,000 acres of public coal lands, located principally in Wyoming, Montana, Colorado, Utah, and New Mexico. Of these it is believed that 30,000,000 acres are underlain with what may be termed fine coal.

Assume that the average valuation which will be placed on these lands is $50 an acre, which according to the rec-

ord of present valuations appears to me conservative, and that on the remaining 20,000,000 acres an average valuation of $25 is placed. This would give a round figure of $2,000,000,000—a sum almost too big to contemplate.

If these figures of acreage and valuation are thought too extravagant, it may be remarked that the coal figures are constantly expanding, and that every year's geologic work by the government adds additional areas to our coal map.

IMMENSE COAL FIELD RECENTLY DISCOVERED IN ARIZONA

Thus, in congressional testimony the other day, Director Smith, of the Survey, mentioned a new coal field in Arizona, not previously included in any coal estimates, which he stated probably contained a tonnage equal to all the coal mined in the United States since the discovery of the first mine.

Two good results from this coal valuation work are, first, that the receipts from the coal-land sales go into the Reclamation Fund, for the irrigation of desert lands by the government and the creation of homes—for every acre of coal land sold at, say, $300 a farm of 10 acres may be reclaimed from the desert by irrigation and a home created—and, second, that the placing of a good-sized price on the land will prevent monopoly of the western coal supply. It precludes the purchase of the lands for mere speculation—holding them indefinitely without mining developments. The management of his big coal-land properties is one instance at least where Uncle Sam is acting the part of the wise landlord in the interests of the people.

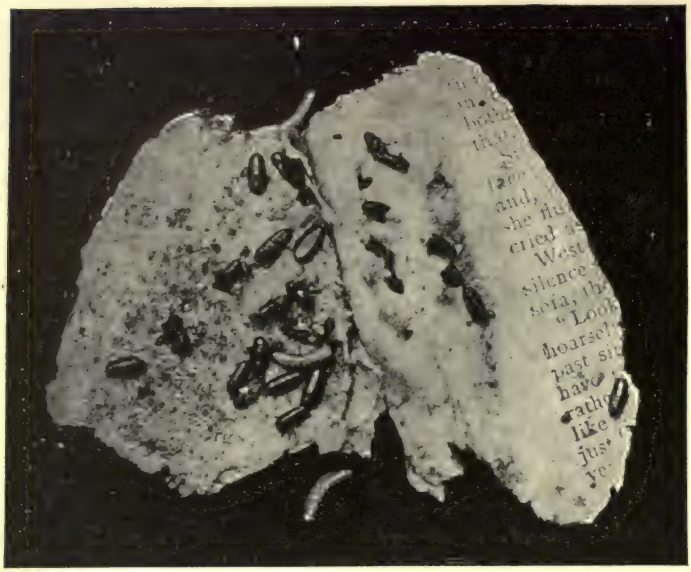
Now follow this work another step. The Geological Survey values the coal lands not only according to tonnage per acre, but according to quality of coal. There are all grades of coal, ranging from brown lignite—only a step removed from peat—to anthracite, produced under enormous pressure and friction, and the fuel-testing work of the Survey determines the number of heat units and the energy values of coals of the various beds.

Further than this, the government has inaugurated a practice with respect to its own coal purchases which will doubtless before long become the rule in private coal buying, namely, paying for coal on the basis of its heating value—the *British thermal unit* basis.

The Geological Survey samples all Uncle Sam's coal purchases and makes tests which show what the coal will do practically. If the coal falls below a certain standard a deduction is made in price; if it exceeds that standard a higher price is paid.

The present practice of coal purchase is to a considerable extent buying a pig in a poke—you get the weight but you don't know the quality. The new practice is eminently fair to both producer and consumer.

Government purchases alone amount to $10,000,000 annually, and the public saving by this exact method of purchase amounts to hundreds of dollars daily. Applied to the country at large it would represent millions of dollars a year.



FLY LARVÆ AND PUPÆ IN WASTE PAPER (ASH-PIT REFUSE), NATURAL SIZE

Photographs by Robert Newstead; by courtesy of the Liverpool School of Tropical Medicine

Egg of house-fly greatly enlarged, showing the segments of the larvæ through the cuticle

PRIVY VAULTS, SWARMING WITH FLIES, ADJOINING KITCHEN DOOR

These conditions, inviting disease and insuring the pollution of food, are practically duplicated in hundreds of towns besides Pittsburg, in which this photograph was taken

FISHES THAT CARRY LANTERNS

SEVERAL years ago this Magazine published a description of the angler fish, well known along the New England coast because of a device by means of which it lures and catches other fish.* This device consists of filaments or tendrils resembling seaweed, which are attached to the head.

When the angler is hungry it hunts out a convenient place in shallow waters, where its color and markings make the fish indistinguishable from the sea-bottom. Here it lies quietly, often as if dead, while its floating filaments, kept in motion by the tide, decoy other fish, which never discover their mistake until too late to escape from the angler's merciless jaws.

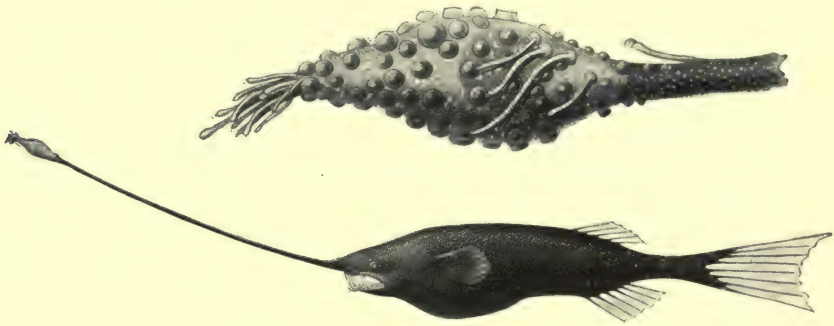
This angler fish is the only one of its kind frequenting the shallow seas of northern Europe and North America, but there are many other related species inhabiting the deep seas of almost all parts of the globe, as well as lurking in the tropical groves and in the sargasso meadows of the Atlantic Ocean. These relatives of the angler are the subject of a bulletin by Theodore Gill, "Angler Fishes, Their Kinds and Ways," recently published by the Smithsonian Institution, and from which these notes are obtained.

The most extraordinary of all the anglers are those that carry lanterns to see with.

"Some stout-bodied anglers resorted to deep and deeper waters, where the light from the sun was faint or even ceased, and a wonderful provision was at last developed by kindly nature, which replaced the sun's rays by some reflected from the fish itself. In fact the *illicium* (a prolongation of the spine) has developed into a rod with a bulb having a phosphorescent terminal portion, and the 'bait' round it has been also modified and variously added to; the fish has also had superadded to its fishing apparatus a lantern and worm-like lures galore.

"How efficient such an apparatus must be in the dark depths where these angler fishes dwell may be judged from the fact that special laws have been enacted in some countries against the use of torches and other lights for night fishing because of their deadly attractiveness. Not only the curiosity of the little deep-sea fishes, but their appetite is appealed to by the worm-like objects close to or in relief against the phosphorescent bulb of the anglers."

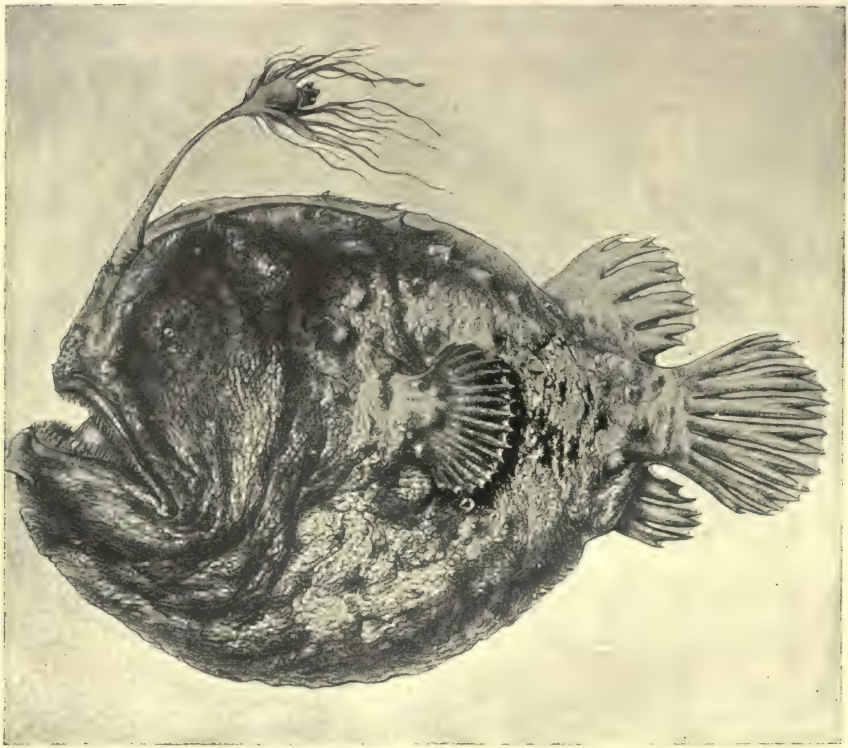
As may be inferred from the size of



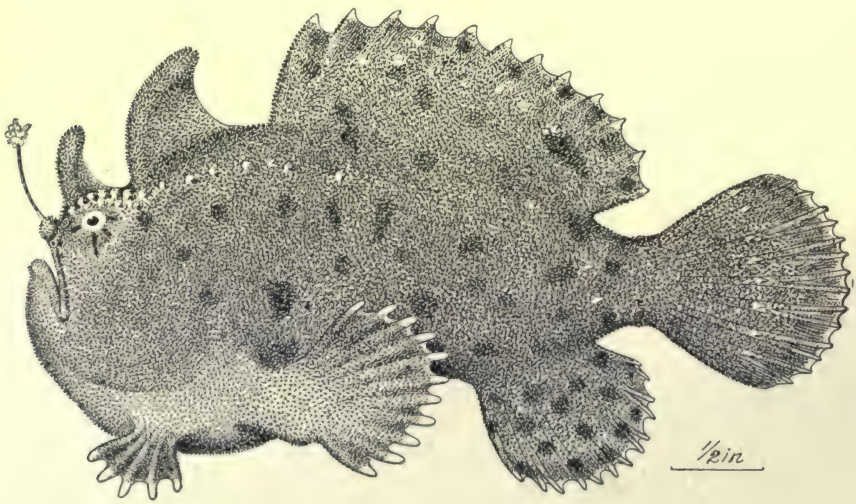
A FISH WITH ITS LANTERN AND BAIT

This tiny fish was dredged in the Indian Ocean at a depth of more than a mile (7,200 feet). The bulb-like upper figure is an enlargement of its torch. The fish is 1½ inches long (excluding the rod and bulb). It swims with the rod and torch pointed straight forward.

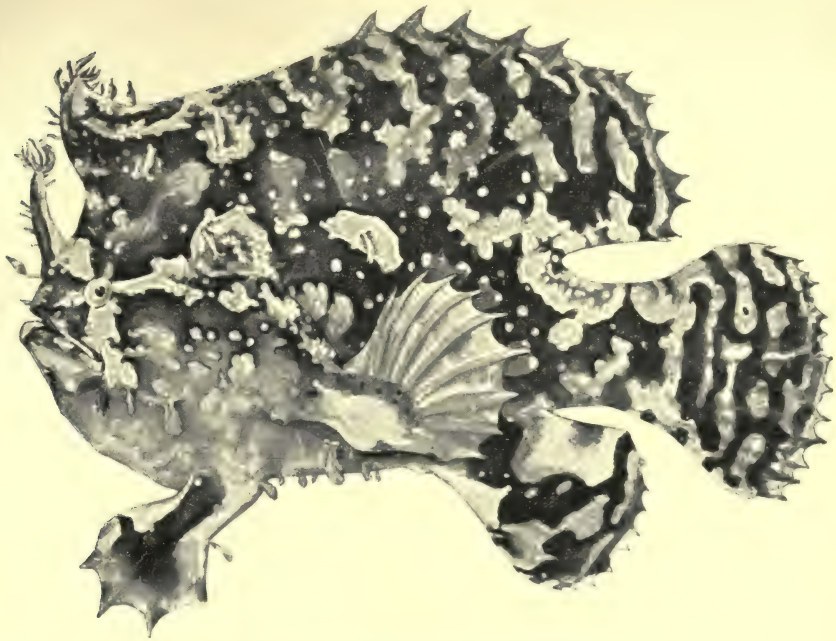
* See "The Purple Veil," by H. A. Largelamb, pp. 335-341, NATIONAL GEOGRAPHIC MAGAZINE, 1905.



AN ANGLER FISH: NOTE THE FILAMENTS OR BAIT WHICH LURE OTHER FISH



ANOTHER SPECIES OF ANGLER: A SEA TOAD OF THE WEST INDIES



A FROG FISH OF THE SARGASSO SEA

ANOTHER SPECIES OF THE ANGLER, EQUIPPED WITH A DIFFERENT KIND OF BAIT

the mouth and teeth of the fish shown on page 455, certain species are ravenous predatory fishes, which may sometimes seize and swallow fishes much larger than themselves. For instance, a specimen obtained by Mr J. G. Johnson, at Madeira, was less than 4 inches long (3.8 inches), but it had actually engorged a fish about twice its own length (7½ inches). The extensibility of the jaws and connected parts, as well as the dilatability of the œsophagus, stomach, and integuments, enabled the captor fish to accomplish this feat. So completely had the captor ingested (but not digested) its victim that "it was tempted to take a bait," and was thus secured for ichthyology.

Another species of the angler are the sea toads, which are inhabitants of tropical seas (see page 454). The brilliant scarlet and other colors which render the sea toads so conspicuous when seen in the jars of a museum collection are quite in harmony in their natural home and assimilate the fishes to the brilliantly colored coral animals and the other organisms, in the midst of which they lurk in wait for prey.

Most of their lives are spent in coral growths. Selecting a fitting place, such as a fissure just wide enough to get into and hold on to, a fish may assume an oblique or vertical position, sometimes looking downward, sometimes with head upward. It then uses its pectoral fins to obtain a good purchase on the rock, and can thus remain stationary indefinitely, waiting till its victims come sufficiently near to be seized.

Closely akin to the sea toads are the frog fishes, which are mostly inhabitants of the "sargasso seas," or "sargasso meadows," in mid-ocean. The sargasso sea is an egg-shaped area in the latitude of Florida, beginning some 400 miles east of Jupiter, and extending thence easterly for 1,700 miles to about the 39th meridian. It is characterized by an unusual quantity of seaweed, also known as "sea-grape," "sea-lentil," etc., which grows luxuriantly on the surface of the sea.

Although floating on the high seas, and thus at the mercy of the winds and waves, nevertheless, those agents operate in such a manner, in conjunction with the currents, that for year after year and century after century nearly the same areas of the ocean are covered by this peculiar plant. The sargasso meadows appear to occupy the same position at the present time as in the days of Columbus, who first described them.

Amid the seaweed thrive most of the species of swimming crabs, cuttle fishes, and other fishes which are found along the shores of continents and islands. Flying fishes of different kinds are also tenants of these fields, although they may rarely show themselves in the air. All these are lured and caught by the frog fish. A single frog fish, whose stomach contents were examined by Mobius, was found to have taken in four fishes, one of which, a pipe fish, over 5 inches long, was coiled in the stomach; a small cuttle fish, and a small portunid crab. All these were still in a recognizable condition.

Another peculiarity of the angler family is the remarkable "nest" which the fish constructs to protect its eggs.

"The eggs are discharged in a jelly-like mass, which, on contact with the water, become immensely distended and form buoyant raft-like receptacles, which float at or near the surface till the eggs are hatched. The rafts are swollen to an enormous size in comparison with the mother fishes, those of the common angler sometimes reaching a length of 36 feet and those of the frog fish a couple of feet.

"The egg raft, after full expansion in the water, is a soft jelly-like mass, quivering to the touch, but withal rather tenacious, moderately uniform in the width, and tapering abruptly and blunt at the extremities. It is also rather thick, with blunt edges. The entire mass is thickly permeated with eggs, which appear to be in several irregular layers. After some days, and when the eggs have matured, the jelly probably dissolves and embryos are apparently thus liberated."

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THE NATIONAL GEOGRAPHIC MAGAZINE

SOME TRAMPS ACROSS THE GLACIERS AND SNOWFIELDS OF BRITISH COLUMBIA

BY HOWARD PALMER

Illustrations from Photographs by the Author

BRITISH COLUMBIA is preëminently a land of mountains. From its eastern boundary—the continental divide of the Rockies—to the rolling Pacific, 500 miles away on the west, the traveler is kept in constant bewilderment by the endless succession of ranges, peak piled on peak and glacier on glacier.

Gaze upward from any forest-filled valley and the gleam from some snow-cap will dazzle you through the tree-tops. Follow that valley to its head and a glacier tongue will stretch downward, luring you still higher to the frigid wonders above.

Other natural features demand admiration — dark gorges, roaring torrents, spraying cataracts, beetling cliffs, dense forests, glorious wild flowers—but the dominant note above all is glistening ice in pinnacle and crevasse.

The climax of this grandeur is attained in the Selkirk Range, whose highest summits indent the clouds 11,000 feet above tide-water. From its rugged shoulders more glaciers hang than are to be counted in all the Alps. Even a native Swiss has acknowledged that the Selkirks "surpass our mountains in labyrinthine organization, in the production of primeval thickets, and the vast number of glaciers."* One can count as many as a hundred of these from even one of the minor summits.

To reach this mountain wonderland there is only one way: take the main line of the Canadian Pacific Railroad and alight at Glacier Station. You are then very nearly at the summit of the range, with splendid peaks and glaciers on every side.

One of the finest of these, the "Great Illecillewaet," pours seemingly out of the sky only two miles away—a short hour's trip from the Pullman car. Another, the Asulkan Glacier, four miles to the south, may be explored by way of an excellent trail leading up through a flower-strewn valley of the same name. At the heads of both these glaciers lie magnificent fields of permanent snow, the one above the Illecillewaet being especially remarkable. Here, at an altitude of 8,500 feet, rounded billows of spotless névé stretch away to the south for 15 square miles—an inexhaustible reservoir for the rifted ice-streams which flow from it at either extremity.

* E. Huber in Schweizer Alpenclub Jahrbuch, 1890-1891, p. 278.

ILLECILLEWAET GLACIER AND ASULKAN PASS: THE GLACIER MOVES NEARLY ONE FOOT EACH DAY (SEE PAGE 461)

"Here, at an altitude of 8,500 feet, rounded billows of spotless névé stretch away to the south for 15 square miles—an inexhaustible reservoir for the rifted ice-streams which flow from it at either extremity."

ILLECILLEWAET NÉVÉ: THE DEVILLE NÉVÉ APPEARS IN THE BACKGROUND, RIGHT OF CENTER

This excellent glacial pass forms one of the few well-defined ways across the long rampart of the Selkirks, though it is hardly practicable for any but mountaineers

EASTERN ESCARPMENT OF ILLECILLEWAET NÉVÉ FROM TERMINAL PEAK

For the past two summers the writer has had the good fortune to spend his vacations in wandering through this Selkirk wilderness. In company with two friends, Prof. F. W. D. Holway and Mr Frederick K. Butters, of Minneapolis, he has "packed" all necessities for extended trips across the passes and glaciers, pushing even into previously unvisited portions of the range.

GEIKIE GLACIER

One of our early excursions was a visit to the Geikie Glacier, which drains the southwestern portion of the Illecillewaet névé as the "Great Illecillewaet" does on the north. The trip promised to be unusually interesting, as the glacier had been traversed only once previously. That, however, was made along its southern margin, while our plan was to keep to the ice itself as much as conditions allowed.

Starting from Glacier, we "trailed it" up the Asulkan Valley and over the pass at its head, 3,700 feet above the hotel, then down 2,800 feet into the further valley, where our glacier lay. Camp was set up near its lower ice-fall shown in the photographs.

This ice-fall was especially remarkable for the way in which the pure white ice, upon reaching the sharp decline, broke up into long, flat-topped ridges or ranks like huge sections of some ancient castle's wall, extending nearly across the glacier. Lower down these were consolidated by the pressure into deep wave-like channels, gradually smoothing out toward the tongue.

Through one of these convenient transverse grooves we crossed the glacier a day or two later. Then, skirting along the steep rocks of its northern margin, we surmounted the fall and took to the smoother ice higher up. After passing over a broad terrace we approached the highest fall of all, where the tremendous mass of ice tumbles down from the névé in a hopeless confusion of splintered séracs.

Glittering towers of ice the size of a city building, grotesquely fashioned and tilted at impossible angles, had been reared aloft by the mighty force from above until the mile of crescent skyline resembled a huge wave frozen by some mystic power as it breaks into thousands of splashes.

It was this great chaos of ice that turned back the Rev. W. S. Green, pioneer explorer of the Selkirks, in 1889. Gazing down upon it from the Illecillewaet névé, he describes the scene as follows: "In its bottom (valley of Fish Creek) a fine glacier wound its sinuous course till lost to sight beyond a bend. Grand precipices flanked it on either hand, and piles of avalanched snow lay half covering the crevasses which were in a regular network over its entire surface. Cautiously we crossed a few snow bridges, but it became too evident that this was no road for the sledges."*

After admiring the impressive spectacle for some time we turned back, for the sun was well down in the west and our position not exactly suitable for a bivouac. We followed our route of ascent to the middle terrace, and then, crossing this, continued to camp along the southern bank.

On the way rather emphatic proof of the glacier's movement was afforded us. During a halt by a tiny stream trickling down a crevice in the ice, one of the party knelt down to drink. His surprise may be imagined on seeing the crack open slightly and the whole stream disappear bodily into its depths.

The movements of the Geikie Glacier, as far as the writer is aware, have never been measured. In all probability they are comparatively small, for the stream, as above mentioned, contains a sharp bend with closely constricting walls, which would greatly retard the motion by their excessive friction.

The Illecillewaet and Asulkan glaciers, however, have been carefully studied, the former from as early as 1888, when the Rev. W. S. Green set out a line of stakes across the ice to measure its rate of flow. His maximum result was 12 feet in 20

* Proceedings of the Royal Geographical Society, vol. XI, 1889, p. 160.

CROSSING GEIKIE GLACIER

CREVASSES IN GEIKIE GLACIER: MOUNT FOX BEHIND (10,576 FEET)

UPPER ICEFALL OF GEIKIE GLACIER

MIDDLE ICEFALL OF GEIKIE GLACIER

"We unanimously decided that the Geikie Glacier was the finest we had seen in the Selkirks. Longer there are and greater, but for purity, variety of ice formations, and general interest the Geikie is unsurpassed"

LOWER ICEFALL OF GEIKIE GLACIER FROM SLOPES ON SOUTH SIDE OF VALLEY

GENERAL VIEW OF GEIKIE GLACIER ABOVE LOWER ICEFALL

DEEP, WAVELIKE CHANNELS OF THE LOWER ICEFALL OF GEIKIE GLACIER (SEE PAGE 461)

days—a rate of nearly a foot and three-quarters per day.

From later measurements of this glacier by George and William S. Vaux, Jr., and the Canadian Topographical Survey (1902), the average maximum rate of flow for several years is made to be about 6 inches per day.*

The Asulkan Glacier for 10 days in 1906 had an average daily motion of 6.7 inches.†

We unanimously decided that the Geikie Glacier was the finest we had seen in the Selkirks. Longer there are and greater, but for purity, variety of ice formations, and general interest the Geikie is unsurpassed. The stream descends for two miles below the Illecillewaet névé, reaching the extremely low altitude of 4,200 feet.

Not long after our day on the Geikie Glacier we struck camp and packed the outfit over Donkin Pass (8,600 feet), the lowest notch in the Dawson Range to the south. Crossing the boiling torrent from the Bishops Glacier, 2,000 feet below the pass, we found a beautiful camping spot on the westerly flanks of the Bishops Range, and set up our tent for a week's stay.

BISHOPS GLACIER AND DEVILLE NÉVÉ

From here we made an interesting trip over the glacier last mentioned to the divide and then down the icy slopes beyond to the Deville névé. This excellent glacial pass forms one of the few well-defined ways across the long rampart of the Selkirks, though it is hardly practicable for any but mountaineers. A survey party, while traversing it, in 1902, very nearly lost one of its members through the breaking of a snow bridge. Mr A. O. Wheeler writes of the incident as follows:

"We were descending the Mitre Glacier (now known as the Bishops Glacier) some distance from the sides, and were threading our way among the crevasses, when a shout behind caused the leaders to turn quickly around. No one was to be seen. My assistant had apparently vanished from the face of the earth. A second shout drew attention to the brim of a hat and an arm appearing above the edge of a crevasse. He had broken through the snow, fortunately catching his ice-axe on the opposite edges of the ice. The pit apparently led to the center of gravity, for we could perceive no bottom. It was a lucky escape."*

The beautiful Deville snow-field lies two miles south of the Illecillewaet névé, severed from it by an ice-walled gap called Glacier Circle. The two bear a striking resemblance to each other. They are of about the same area, both lie north and south at the same elevation, and both are buttressed on the east by a line of small rock peaks which rise with great regularity above the valley of the Beaver River. The Deville névé, however, is nourished by three large feeders, in this respect differing from the Illecillewaet.

BLACK GLACIER AND PURITY RANGE

A second expedition from our Bishops camp was made over the ridge of that name to the south. In the valley beyond a most interesting glacier is to be found flowing parallel to the Bishops Glacier in the same direction. But instead of being a single stream, this glacier is the product of four magnificent confluents, and, instead of having a uniformly white surface, a series of high moraines is freighted along, one from each member. For this reason it has been named the Black Glacier, though rather inappropriately, as a glance at the photographs will show (pp. 472, 478, and 479).

The panorama of this glacial basin as viewed from the Bishops Range is one of the most imposing to be found in the Selkirks. It is as if a bit of arctic landscape had been carried south and dropped down upon a rock-ribbed range far above tree-line.

The "Purity Range" seems a fitting name for the chain. Its dominating peak from this viewpoint is the glacier-draped

* See "Selkirk Range," by A. O. Wheeler, p. 360.

† Canadian Alpine Journal, Vol. 1, p. 147.

* Appalachia, vol. x, p. 133.

LOWER ICEFALL OF GEIKIE GLACIER

"Glittering towers of ice the size of a city building, grotesquely fashioned and tilted at impossible angles, had been reared aloft by the mighty force" (see page 461)

CURIOUS SNOW BRIDGES AND CREVASSE FORMATIONS ON UPPER PLATFORM OF GEIKIE GLACIER

PASS ACROSS PURITY RANGE WITH NAMELESS PEAK: BLACK GLACIER AT BOTTOM.
The pass is to the left of the central peak (see pages 473 and 484)

massif of Mount Kilpatrick (10,624 feet), first ascended in 1909 by E. W. D. Holway, F. K. Butters, and H. Palmer. To the left, barely visible over the col at the valley's head, rises Mount Wheeler (11,023 feet), second only to Mount Dawson among the monarchs of the southern Selkirks.

Next to the west come four nameless peaks, and then the range terminates in the majestic mass of Mount Purity, perhaps the most striking peak of all. Seen from the upper slopes of the Bishops Range, this silvery spire, with its graceful aretes, symmetrical buttresses, and unique snow curtain lighted by the afternoon sun and outlined against a sky of deepest blue, forms a picture never to be forgotten.

BATTLE RANGE AND BATTLE GLACIER

Beyond the Purity Range to the south the country is practically a *terra incognita*. A strip averaging about four miles wide along the range is shown on the government map, but the data for this was obtained from distant photographs taken on the summits of Mounts Wheeler and Purity, and as far as we could learn no one had actually crossed the range to explore the district in detail. Below this strip the map was blank except for the words "Battle Range" in heavy type.

Since our first view of this region from the Purity Range it has interested us, and we had desired to accept the covert, though none the less alluring, challenge of the map, but previously to July, 1909, conditions had prevented our doing so. That month, however, found our party of three encamped on the flanks of the Bishops Range, all preparations completed for a visit to the virgin valley of the Battle glaciers.

The chief difficulty in our undertaking was to find a way down the southerly slopes of the Purity Range, for from Mount Kilpatrick these appeared to form a continuous wall of practically sheer cliffs along that side. The northerly slopes, on the contrary, looked accessible everywhere, so we selected the deepest notch in the skyline for our first trial. This cut the range near the middle and could be reached with facility from our camp. It took a morning's hard work to solve the maze of crevasses in the intervening feeder of the Black Glacier, but toward 2:30 p. m. we pushed into the col.

One hasty glance over showed that we had probably found a pass, for a steep finger of snow reached up from the further glacier right to our feet, bridging the rock wall in the neatest manner possible. Still, the entire route of descent was not visible, and a crest in the glacier below suggested the beginning of an ice-fall likely to form a serious if not insuperable obstacle, but we unanimously decided to risk it notwithstanding.

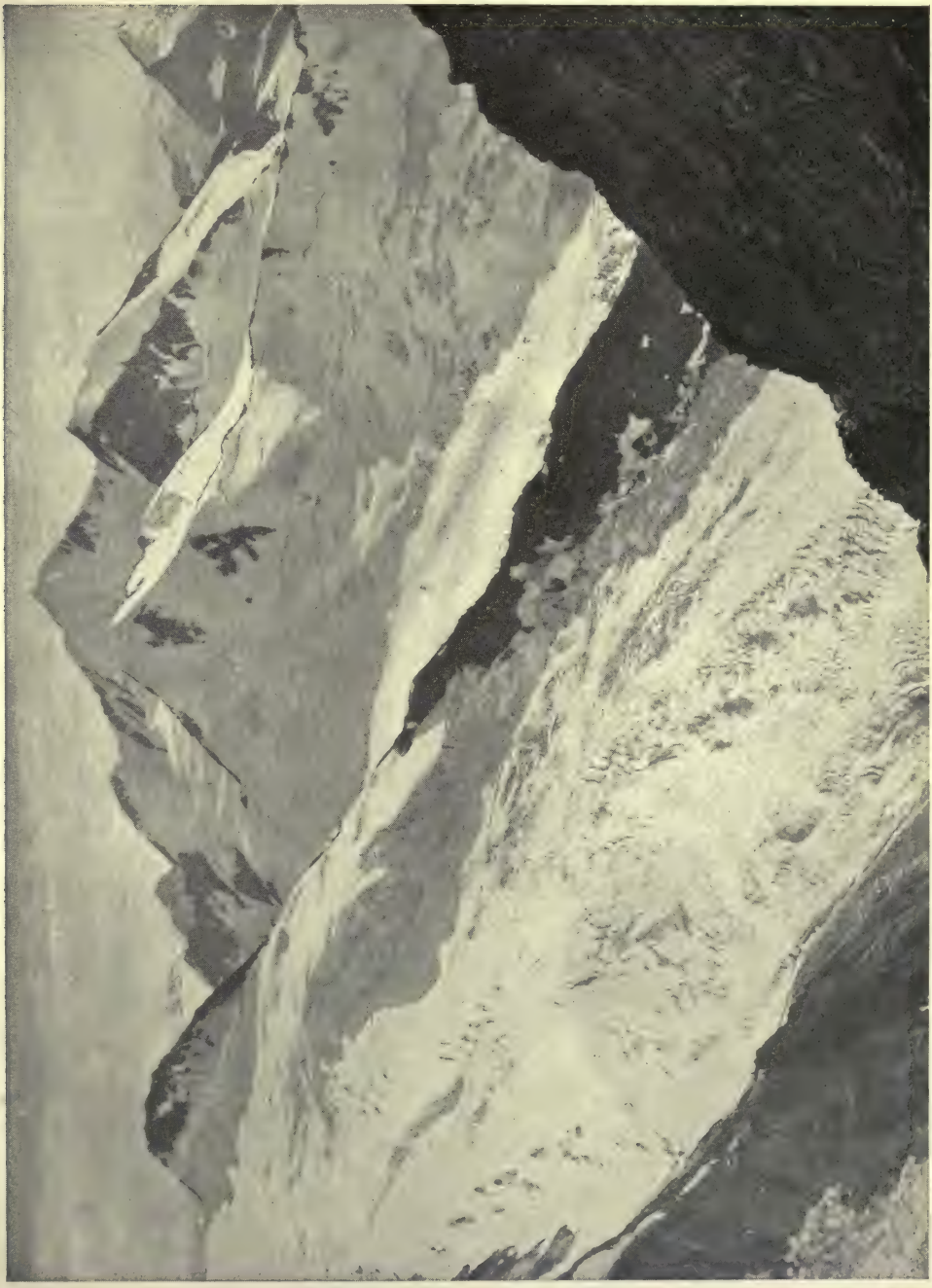
The view of the deep valley of Battle Creek was grand beyond description. On either hand rose rocky walls fringed with hanging glaciers, while below them in the valley wound another, the huge Battle Glacier, four miles from source to tip. Across the valley in the background soared the nameless black peaks of the Battle Range in formidable array. Sharp ridges of nearly equal height walled in high glacier basins, below which black, rocky slopes, shining with moisture, pitched steeply into the valley.

The most elevated point seemed to rise at the right, where a single rounded summit pierced the sky at an altitude not far from 11,000 feet. From its shoulders the snow fell away to the largest glacier in the group. All this formed an alluring, although somewhat forbidding, prospect.

We returned to camp and a day or two later again made the col, this time laboring under 40-pound packs. With scarcely a pause we plunged down the snow to the glacier and began a winding march between its crevasses. As we had feared, the crest seen from above concealed a huge ice-fall.

The glacier was gashed from side to side for fully 2,000 feet down. Surely our way was not there. Carefully following the edge, we turned to our left and made for the margin of the stream, where at length we were rewarded by

CYPRIAN PEAK (10,712 FEET) AND BISHOPS GLACIER (SEE PAGE 469)



MOUNT PURITY (10,457 FEET) FROM CYPRIAN PEAK

PANORAMA FROM MOUNT PURITY TOWARDS NORTH AND NORTHEAST

From left to right, Dawson and Bishops Range; then Mounts Wheeler and Kilpatrick at right. The precipitous southern slope of Purity Range is well shown by black cliffs in foreground to right

MOUNT KILPATRICK (10,624 FEET), FIRST ASCENDED IN 1909 BY MESSRS E. W. D. HOLWAY, F. K. BUTTERS, AND HOWARD PALMER (SEE PAGE 473)

the discovery of a moraine almost hidden under winter snow. Descending its curving crest, in half an hour we found ourselves at the foot of the ice-fall on the great level reaches of the upper Battle Glacier.

The sun had now set for us, though it was but 4 o'clock, burying the glacier as well as the valley below in deep shadow. Only Grand Mountain and the peaks in its chain were still bathed in bright sunlight. Haste was indeed imperative were we to camp before nightfall in the gloomy depression three miles below. Accordingly after only a moment's halt we shouldered our burdens and resumed our way. The next two hours passed in a monotonous grind, first through the slush of the glacier and then over the sharp stones of a great medial moraine which appeared to afford the quickest road to the valley. On our left the other branch of the glacier, emerging from a dark defile, joined ours, the two forming the mile-wide stream of Battle Glacier, shaped like a huge letter Y.

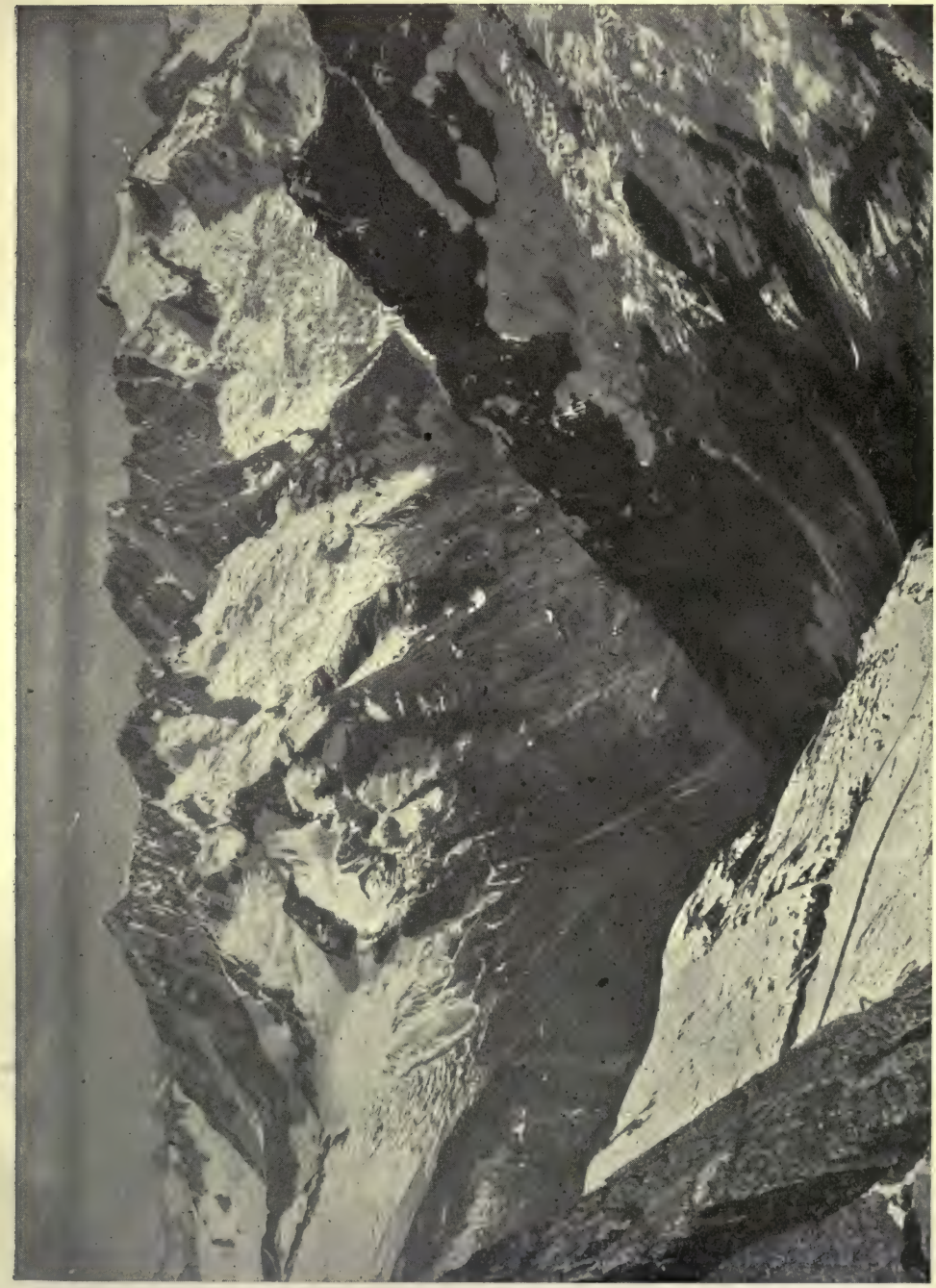
Dusk was upon us as we approached the crest of the high terminal moraine which had hitherto concealed the valley's depths where we hoped to camp. For the last four miles our route had lain through a forlorn waste of ice, snow, and jagged rocks. A few sparse patches of green grass did indeed clothe the slopes to the left here and there, but they only served to emphasize the barrenness by contrast. Not even a marmot's whistle had cheered us with its shrill note.

Unless our surroundings changed very considerably in the next hour, a night on the sharp stones of the moraine, with nothing to eat but crackers, chocolate, and dried fruit, was all we could look forward to. Accordingly it was not surprising that we hurried rather anxiously up the rocky slope toward the top.

MOUNT KILPATRICK AND BLACK GLACIER (SEE PAGE 469)

THIS MASS OF BOULDERS AND ROCK IS FREIGHTED ALONG BY BLACK GLACIER (SEE PAGE 469)

BATTLE RANGE AND BATTLE GLACIER, SEEN FROM THE SUMMIT OF MOUNT KILPATRICK (SEE PAGE 473)



ANOTHER VIEW OF BATTLE RANGE AND VALLEY FROM MOUNT KILPATRICK

"A SINGLE MATTERHORN-LIKE SUMMIT TOWERED IN LONELY SPLENDOR"
(SEE PAGE 483)

The scene which greeted us was indeed one of wildest grandeur. Two hundred feet below us a raging torrent foamed out from beneath the glacier, racing into a narrow gorge with a thunderous roar. Lower down it emerged, and we could follow its course for perhaps a mile further winding between banks densely overgrown with alders. There the valley widened out and its gradients became gentler, but of forest there was hardly a patch. Alders and steep grassy slopes were the rule. Nearer, on either hand, its sides slanted abruptly back in rough rock-piles, breaking into cliffs higher up, where ice fringed the skyline and sharp summits stood out black against the evening sky.

It was a rather disheartening outlook for a hungry party with nothing but green wood in sight for miles. But we couldn't be worse off than where we were on the glacier, so we prepared to push further down the gorge on the chance that something better would appear.

Just then what was our surprise to see on a ridge of the moraine not 200 feet away a fine yearling grizzly bear. He had been traveling in our direction, but out of sight below the moraine, and his astonishment at finding himself suddenly face to face with three strange creatures was ludicrous to behold. He stopped short, looked us over for a full minute, then gave a deep "hoo wuff" and, turning around, disappeared. Regretting that our cameras were tightly strapped up in our packs, we continued our way down into the gorge.

We had progressed hardly a hundred feet when, above us on the mountain side, lo, another grizzly was sighted, this time a full-grown mother bear with a cub. She was nosing about in the alder bushes apparently unaware of our presence, and looking for all the world like a contentedly grazing cow.

With no arms but our ice-axes and no trees nearer than 5 miles, it did not seem wise to disturb the brute or to give her any reason for desiring to make our acquaintance, so we slid down the slippery forefoot of the glacier to the edge of the

torrent and pushed on down the valley, rather anxious, it must be admitted, as to whether there were any other specimens in the menagerie.

After a half hour's rough tumble over the boulders along the stream and through the alders fringing the canyon's lip, we reached the more open portion of the valley seen from above, and soon found a place in an old avalanche track where dry wood was abundant and the tent could be set up among the stones.

It was anything but an ideal camping spot. The only space for the tent consisted of a 6-foot stretch of water-worn rocks, the interstices between which were only partly filled by glacial silt, leaving their "summits" to indent the particularly weary portions of one's anatomy. Moreover, even this small area had to be cleared of the ever-present alders. But we were in a far from critical mood, and, in comparison with what might have been our lot, this was luxury.

A fire, soon kindled, dispelled the gloom and facilitated our lumbering and culinary operations. Ere long the tent was up (though rather precariously) and copious draughts of hot tea and pea soup were repairing the ravages of a hard day's work.

We had climbed about 4,000 feet under 40-pound packs, and descended the same distance, with 600 feet additional, covering a distance of 10 miles through untraversed country.

Next morning we were up early to view our surroundings. In the gloom of our arrival the heights had shown merely as dim shadows against the sky. Sounds of rushing waters in varying keys had reached us intermittently as the wind blew gustily down the valley, so we hoped for glimpses of waterfalls not far away. Not were we disappointed.

Almost directly behind our camp a beautiful cascade leaped out of the sky and came tumbling down from ledge to ledge in a foaming thread for a full 300 feet. Further to the right another gushed out, evidently the drainage from a glacier that was nearly hidden in a deep notch.

Fifteen hundred feet almost straight above this a single Matterhorn-like summit towered in lonely splendor, forming with its lower and more distant slopes the eastern wall of the valley. The corresponding wall at our backs rose even steeper to a belt of cliffs which extended for two miles along that side (west) and supported hanging glaciers as far as we could see. Its southerly termination was a sharp rock peak, around which the valley swung abruptly to the west.

Opposite this point stood the fine group of peaks shown on page 486. Altogether the scene presented the sharpest contrasts between heights and depths that we had seen anywhere previously.

After a day spent in improving the camp we pushed down the valley in order if possible to view its course beyond the turn just mentioned. We followed a well-worn bear trail that wound through soft grassy alps, where evidently the animals often found comfortable quarters, to a point where the torrent entered a small canyon. Then we turned to the left and struck up a very steep alder-matted slope, attaining at length an altitude of 5,800 feet—2,400 feet above the valley. From here we obtained splendid views up and down its length, including one of a fine glacier basin below Mount Sugarloaf.

We had come a distance of about a mile and a half from camp in an airline, during which the valley dropped 500 feet. The creek in consequence had in places cut its channel through the loose morainic material to a depth of 75 feet below the general level. Lower down the gradient became gentler at an altitude of approximately 3,000 feet, allowing the stream to take a winding course through verdant meadows and groves of evergreens until it once again turned westward and was lost to sight.

Numerous tributaries from the high glaciers of the Battle Range bounded down over smooth rocky slants to join it, in two cases issuing from hanging valleys that cut back into the heart of the range. Our plan was to continue still further, but a heavy shower forced

NAMELESS PEAKS IN PURITY RANGE: THE PASS IS TO THE RIGHT OF THE CENTRAL RIB (SEE ALSO PAGE 472)

VIEW FROM THE SUMMIT OF THE PASS, SHOWN IN PRECEDING PICTURE, LOOKING DOWN INTO BATTLE CREEK VALLEY AND OVER BATTLE GLACIER

OUR CAMP IN BATTLE CREEK VALLEY: PART OF BATTLE RANGE IN DISTANCE

us to turn back, and we reached camp in a soaking condition.

The rain continued intermittently, but during the lulls we managed to cook supper and dry our clothes somewhat. Heavy showers battered the tent in the night, giving a severe test to its waterproofing. This might have been better, but we felt grateful that only a fine mist penetrated.

In the morning, under lowering skies, two of the party ascended the glacier occupying the notch east of camp and reached a knob near the arête joining Grand Mountain and Mount Sugarloaf. From this they obtained unobstructed views throughout the upper reaches of the valley. Everywhere steep rocky walls and jagged cliffs fringed with glaciers met the eye, making it apparent that the camp was not favorably situated for any ascents in its vicinity.

Rain again prevented our accomplishing anything the following day, and, as indications promised a storm of several days' duration at least, it seemed useless to remain longer, especially as our food supply was insufficient to allow us to move down the valley to a more favorable spot. Accordingly we started back on the fourth day over the same route, arriving at our camp on the Bishops Range at 9:30 p. m. in a howling snowstorm. A few days later we ended our outing by returning to Glacier.

Our experiences in the upper portions of the valley support those of W. S. Drewry and P. A. Carson,* both of the Dominion Land Survey, who on different occasions penetrated the valley from its mouth with a view to locating a survey station in the Battle Range. They found the going as bad as possible, and the former was "confronted by sheer precipices of rock and ice at every attempt" to make an ascent.

There is little doubt but that the Battle Range on this side is one of the most difficult in the Selkirks from the climber's point of view. The valley is a low one, which means a long pull to timber line and a bivouac there before snow and ice work commences. Conditions ought to be more favorable on the south side of the range, but nevertheless the sharp aiguilles and threatening towers will doubtless offer most interesting problems to an attempt from that direction.

* Annual Reports of Department of Interior, Canada, for 1892 and 1907.

WHERE WOMEN VOTE

By Baroness Alletta Korff

IN FINLAND for nearly three years women have been members of Parliament, and for the first time in history have "taken their places in a legislative assembly side by side with men, elected by universal manhood and womanhood suffrage."

The law granting the franchise to women came into effect on the first of October, 1906, so that now it is possible to estimate, in some degree at least, the value of the work that the women have done and the effect that woman suffrage has had upon the country at large.

Although at the time the suffrage was granted it seemed to people outside Finland radical and even revolutionary, in Finland itself the change was looked upon merely as an inevitable step in the natural process of the political and social evolution of the country, and was received without any signs of excitement whatever.

It is true that in some ways conditions in Finland have been peculiarly favorable to the advancement of woman's rights, but there have been also certain difficulties which do not exist in other countries, and which made the idea of woman suffrage seem an almost chimerical one

even as short a time ago as 1897, when the first official request was made.*

NOT ENOUGH EDUCATED MEN TO MEET THE REQUIREMENTS OF THE COUNTRY

From an educational point of view the women in Finland have been very fortunate, as there are many excellent schools for girls and a number of co-educational schools throughout the country which prepare students for the University examinations. Girls have been admitted to the University since 1878, and they not only attend lectures but take part in all branches of university life: they participate in all the celebrations and festivities, and are members of the various clubs and student organizations, in which they are on a footing of perfect equality with the men and are frequently elected to various official positions. After they graduate from one of the several high schools or from the University there are many branches of work open to them.

They may become teachers even in the state schools for boys, cashiers or bookkeepers in banks, clerks in the state archives, and in many branches of the civic administration. There are really not enough educated men to meet the requirements of the country, and consequently the cooperation of the women is a matter of vital importance. It not infrequently happens that even married women in comparatively good circumstances seek employment outside their homes.

Having thus such an excellent foundation to build upon, it is small wonder that the woman's movement soon found many active supporters. In 1863 the Diet had accorded the municipal vote to women taxpayers living in the country, and in 1872 to women living in the towns, all of whom were also given the right to be elected members of certain local self-governing bodies. In 1900 the women social democrats included the suffrage in their program, but the special activity for the suffrage began only in the year 1904, although in 1897 a petition had been officially presented to the Diet at the request of the "Finnish Woman's Association."

The reason why so little was done in direct furtherance of the cause of woman suffrage between the years 1897 and 1904 is that just at that time Finland was passing through a severe political crisis. The struggle which the country was trying to wage against what seemed to be hopeless odds roused all the women of the country to action and made them realize the immense influence that political questions had upon the welfare of their country and upon their own individual lives. Thus they learned by practical experience the value of, and the necessity for, organized cooperation.

When all the women of the country had once been thus united by a strong bond of common interest, it was only natural that when the political crisis had passed the women should work together in an attempt to gain a recognized position in the civil and political life of the country.

By the autumn of 1904 the political situation had changed materially and public gatherings were once more allowed. The first large meeting for the discussion of the question of woman suffrage was convoked by one of the women's societies, and was attended by over one thousand women from different classes of society and from different parts of the country. The petition which the women presented to the Diet at this time was not dealt with, however, for the situation of the country was still precarious.* Women nevertheless continued to play an active rôle.

WOMEN CHOSEN TO SERVE AS MEMBERS OF A STRIKE COMMITTEE

After the outbreak of the October revolution in Russia (1905), a sympathetic strike was declared in Finland, and several of the members of the central

* Unofficial requests had been made previously by both the women's societies.

* In this petition equal suffrage for men and women was demanded, and for the first time a demand was made that women be granted the right to sit in Parliament.

committee elected by a mass-meeting to manage the details of the strike were women.

The first action taken by the committee was to close all the liquor shops, saloons, and bar-rooms, and to organize a volunteer police force to keep order. After the second day the markets were reopened and the strikers were not allowed to cut off the water supply. In short, the strike was managed in a most orderly and systematic way, and no outrages of any sort were committed.

During the course of the strike numerous deputations were sent with petitions to the Governor General, and in each deputation there were women members. Thus, even in moments of grave political danger and at times when the utmost moderation and foresight were needed, the Finns were not afraid to trust their women.

The strike was ended by an imperial manifesto issued on November 4, 1905, which reinstated Finland in its earlier rights, and in the manifesto universal suffrage was spoken of as a reform that might soon be realized. This gave a great impetus to the work among the women. They were determined that when the question of the suffrage came up for settlement, universal suffrage should be granted to them as well as to the men. Both of the women's associations arranged numberless lectures and meetings. More than 300 women's meetings were held in different parts of the country. At one large meeting, called by the "union" on December 2, 1905, there were representatives from 122 different places, many communes sending two, three, and four representatives in order that all social groups and all shades of opinion might be represented.*

WHEN WOMEN ASKED FOR SUFFRAGE IT WAS GRANTED AS A MATTER OF COURSE

This was only one of a number of similar meetings. Many of the young women students in the University traveled about the country lecturing on woman suffrage, and there were also numerous meetings arranged and led by peasant women.

Curiously enough there was almost no opposition to the measure, and when it came before the Representation Reform Committee only two members voted against it, and in the Senate also there were only two counter votes. Then the question was put before the Diet, and was included in the imperial proposal submitted to the Czar and signed by him on the 29th of May, 1906.

The Constitution Committee within the Diet recommended women's political suffrage and eligibility for the following reasons: "At present women in Finland get exactly the same education as men, even in the same schools, since co-education has been adopted in wide circles. Women in our days are engaged side by side with men in many different lines of work, and the experience from these ordinary fields of labor, as well as from women's participation in social work and in philanthropy, is such that there is no reason to fear that women should not use their suffrage as well as men. Finally, women themselves have shown a strong desire to get it."*

Thus at the time that the suffrage was extended to women it seemed so natural and inevitable that every one received the news quite calmly, and even at the time of the elections there were no evidences of popular excitement, though by the change from limited to universal suffrage the electorate was suddenly increased from 10,000 to 1,500,000. The extreme orderliness, even on the two election days, was a matter of great surprise to all the foreign correspondents, who seemed to regard it as quite an incomprehensible state of affairs.

The various women's clubs and women's associations played an important rôle at the time of the elections and immediately before. They used every effort to encourage women who could speak well to go about and address meet-

* "Nylid" for November, 1905.

* "Englishwoman's Review," 1907.

ings, and they made it possible for them to do so, and for poor women to go to the polls on election day, by providing competent and suitable women to take care of their homes. Women members were appointed on all the electoral boards, and when the tickets were being made up the women showed great moderation, asking only that one woman's name be inscribed as over against two men's names on each of the party tickets.

As soon as the law had been passed granting the suffrage to women, women's interests were included in the various party programs, and, as each of the already-organized parties was very anxious to gain as many votes as possible, it seemed neither advisable nor necessary for the women to form a new and separate party of their own. The whole object of their endeavor was not to bring a new party into politics, but to infuse a new element into the parties already existing.

MORE WOMEN VOTERS THAN MEN VOTERS

The very great interest that the women took in the elections may be gathered from the fact that in Helsingfors, the capital, at the time of the second elections (in 1908), there were 19,640 women voters and 15,516 men voters registered.* It is true that the majority of the women voted for men, as there were only 26 women elected in a house of 200, but one woman received a larger number of votes than was given to any of the men candidates of her party.

In 1906, of the 11 Agrarians elected, 1 was a woman; of the 25 Swedes, 1; of the 25 young Finns, 2; of the 59 Old Finns, 6, and of the 80 Social Democrats, 9 were women, so that the proportion of women to men was approximately the same in all the parties except the Swedish.

Although the women deputies did not constitute quite one-tenth of the whole Diet (19 were elected in 1906), they proposed no less than 26 bills and resolutions, a statement of which will perhaps give the best idea of the special subjects in which the women were interested.

* At the time of the first election in 1906 no separate count was kept of the number of men and women voters.

THE LAWS WHICH THE WOMEN ADVOCATE

There were three different bills for the abolition of the guardianship of the husband over his wife, and a new woman's property act; one for more rights of mothers over their children; four for raising the age of protection for girls; two for raising the age of legal marriage for women from 15 to 17 or 18; four in regard to the legal status of illegitimate children; two petitions for more extensive employment of women in state service; for a state subsidy in behalf of schools for domestic training; for an annual subsidy of 20,000 marks for temperance; for obliging municipalities to appoint a midwife in each parish; for an amendment of the paragraph of the Agrarian law which stipulates that sale of an estate annihilates all lease contracts; for encouragement and extension of co-education; for abolition of the law on domestic service; for the construction of a specified railway; for the establishment of a maternity insurance fund; for the appointment of women as sanitary inspectors; for amendment of the law on litigation in so far as women shall be granted the same rights as men in regard to legal assistance; for subventions to the distribution of free meals to school children; for pardoning the Finns that took part in the Sveaborg revolt; for the abolition of disciplinary punishments in prisons; for making it a penal offense to insult a woman on the public roads or in any other public place.*

Up to the time of the dissolution of the first Diet (March, 1908) only three of the women's bills had been debated and decided upon—the institution of midwives, domestic training, and the raising of the age of marriage from 15 to 17. Various other bills would probably have been passed by the Parliament if the sudden dissolution of the Diet had not put a stop to all parliamentary work.

* Report for the "International Woman's Suffrage Alliance."

In the elections for the second Diet, which took place in July, the women voters outnumbered the men by more than 4,000 in Helsingfors, and by about 3,000 in the province of Nyland. This time 26 women members were elected. Of the 224 petitions presented to the second Diet, 29 were presented by women, and of these one was for the appointment of a woman sanitary inspector, one for the improvement in the position of women in state service, two for the extension of certain railways, and several for abolishing legal abuses under which women had been suffering. Nearly all the rest concerned various improvements in the care and education of children.

BALANCE OF POWER AMONG PARTIES NOT AFFECTED BY WOMEN

At the time of the second elections the women again joined the already existing political parties and made no attempt to establish a separate party of their own. Once more also the number of women representatives in each party proved to be in direct proportion to the number of men representatives of the respective party. In other words, the election of women members did not in any way affect the balance of power among the parties. This was also true of the third Diet, elected in May, 1909.

The personnel of the women members in the three Diets has been in the main the same. Among those elected to the third Diet were one factory inspector, one principal of a teachers' seminary, two doctors of philosophy (one of them an official in the state bureau of statistics), one principal of a girls' school, one historical writer and lecturer on political questions, one clergyman's widow, one peasant's wife, one girls' school teacher, one public-school teacher, five seamstresses, one editor of a Social Democratic women's weekly (a former servant girl), one hooper's wife, one crofter's daughter, two Social Democratic organizers, one without specified profession. Thus, as among the men, all classes of women are represented.

As the majority of the representatives are over 40 years of age, it is safe to assume that in almost all cases their children, if they have children, are of school age, or at least old enough not to suffer from their mother's temporary absence from home; and, moreover, in all but four or five cases, the women members of Parliament were previously engaged in wage-earning occupations which were more confining and less well paid than their present positions. In other words, the families of the great majority of women members of Parliament have gained socially and economically by their election to Parliament. It is perhaps interesting to note that there are three cases of married couples representing a constituency.

As regards the work of women members of the Diet, it is precisely the same as that of the men members, there being women representatives in all of the various committees. One woman, for example, is a member of four different committees—the committee which deals with questions of constitutional law, that which prepares bills concerning social and labor questions, that which presents the final parliamentary reports to the state, and the Grand Committee.

THE ABILITY TO VOTE HAS IMPROVED THE CONDITION OF WOMEN

Before the suffrage was granted to women the vast majority of requests made by them for the investigation of the conditions of life among women workers—for example, women factory-workers—were treated with polite indifference; now that women have the vote, all of their official requests receive serious consideration. Two women factory inspectors have been appointed, and a special appropriation has been made for the work of an investigating committee.

No one who followed the heated debates aroused by the bills concerning the "Married Woman's Property Act," the "Extension of the Mothers' Rights over their Children," and the "Abolition of the Husband's Guardianship over his Wife," can doubt the practical advantage that women have gained by having

women representatives in Parliament. An article which appeared in the *Jus Suffragii* while the bills were pending says: "The women members of the Law Committee, to which the bills were referred, have had to stand a hard fight. The men members in the committee, of all parties, whether bourgeois or Social Democrat, held that only the 'women's-rights women' urged the revision of the marriage laws, and the rest of womankind was content with the *status quo*. When this became known, protests came from all sides. Women of all sorts and conditions sent signed petitions to some of the women members of Parliament urging the revision of the marriage laws, and most of the women's associations took up the question and passed resolutions giving moral support to the women members, and urging the points in the bills upon the marriage question."

Moreover, the possession of the franchise has been of practical use to women, not only by giving them the possibility of improving the conditions of their work and extending their legal rights, but also by helping them directly to better their economic position. Not long ago a test case was brought up by a woman teacher in one of the high schools, who claimed that as she was doing the same work as the men teachers and had passed the same examinations, she should be given the same salary. After a short discussion her request was granted, whereas similar requests made before women had the franchise had not been granted.

SCHOOLS TO TEACH GIRLS TO BECOME EFFICIENT WIVES AND MOTHERS

But as might be expected, the chief interest of the women has been to improve the condition of children. Over 50 per cent of the bills introduced into the three successive Diets have concerned the welfare of children. Many have been for rendering medical aid to poor women throughout the country districts, and for instructing them in the proper methods of caring for infants; many have treated of the improvement and extension of the public-school system and the care of school children; still others have dealt with special classes of children, orphans, waifs, and juvenile delinquents.

Now that the system of home instruction and private tutoring has passed perhaps forever—practically all children of nine or ten are sent to schools, and a large number of them to public schools—it seems only natural that women should take a tolerably intelligent interest in the management and direction of those schools and the state or municipal laws which govern them. When, too, in these days of democracy, the great majority of boys and a large number of girls also must look forward to earning their own living, it is only to be expected that women should feel the vital importance of investigating and, if possible, ameliorating the conditions of industrial life.

One of the noteworthy reforms undertaken by the women has been the establishment of schools of domestic training throughout the country—schools intended to teach young girls to become efficient and capable wives and mothers. These schools are of great importance, especially in the country districts and among the poorer class of people. They are becoming most valuable factors in the cultural development of the country, and are doing more than could perhaps be done in any other way to raise the general standards of living.

Thus the women have succeeded in materially bettering their own position; but they have done much more, for they have also carried through reforms of wide-reaching importance to the moral and social life of the whole community. A striking proof of this may be shown by the fact that in the church synod held in 1908 it was decided to grant women the elective suffrage for sundry church offices.

This motion was brought before one of the most conservative bodies in the country by a member of the synod who had previously been opposed to granting the political suffrage to women, and who introduced the motion of his own accord, saying that since the women had proved

themselves such efficient social and political workers, he felt that it would be an advantage to the church if they should be made eligible to many church offices.

The experience of three years of woman suffrage in Finland has proved, I think, beyond doubt that the emancipation of women is not a thing to be feared or dreaded, but merely a natural step in the evolution of modern society.

When the suffrage was extended to the women they responded with interest and enthusiasm, and have shown themselves capable of serving on all the various legislative committees. They have not disturbed the political balance of power, but have maintained it precisely as before, uniting as women only for the furtherance of social and legal reforms of importance to women, but also of very vital importance to the welfare and prosperity of the community at large.

Families have not been broken up by the woman's vote; rather have they tended to become more united by a strong bond of common interest. Instead of lessening the interest that women take in the education and the welfare of their children, the suffrage has greatly intensified that interest by making it possible for them to regulate and, in some degree at least, to improve the schools to which their children are sent and the different branches of work which they later undertake.

Experience has shown, too, that when the doors are opened, not all women rush madly into political life, but only those who are specially qualified for it; that for the vast majority of women the duties of the franchise consist in little more than casting their ballots, and that even the women who participate actively in political life devote no more time to it than they devoted previously to their extra domestic occupations or professions—that is, that even the small number of women who actually sit in Parliament need not neglect their homes unduly. But last and most important of all, it has shown that the cause that women have most at heart is the care and welfare of children.

NOTES ON FINLAND

DESPITE the obvious dissimilarity between Finland and the United States, the two countries have, nevertheless, many points in common, for Finland stands in much the same position in relation to Sweden as the United States does in relation to England, from the point of view of language, of social institutions, and the position of its women.

The Swedish language, brought over by the Swedes who early settled along the coast, became the language of culture in Finland, and the written language is still identical with the written language of Sweden, but in Sweden it is spoken as English is in England—with a rhythmic cadence and a rising inflection. In Finland Swedish is spoken as English is in America, less formally and with more variation in emphasis. In Finland, also, certain words in common use have changed their connotation, just as certain English words have in America.

But whereas in America the English language is the common language among all classes of the population, and serves as a bond of union which all foreigners coming to the country are anxious to share, in Finland now the Swedish language has become a great stumbling-block.

Formerly the Swedes were in almost absolute control of the social and political life of the country, and the language of the Finnish peasants of the interior had, in the early days, little influence on the general life of the country.

Within the last few years, however, Finland has passed through a marvelously rapid process of evolution. Many Finns of pure Finnish stock have become doctors and lawyers, Senators and college professors; the Finnish peasants have gained political equality and they are now demanding equal educational advantages, so that now the question of language has become a question of vital importance.

The current belief in America seems to be that the life of the country, politically, socially, and intellectually, is something quite distinct and individual, neither

Swedish nor Russian, Latin, Teutonic, nor Anglo-Saxon, and that the language in common use is Finnish.

As a matter of fact the culture of the country and the political institutions were all derived from Sweden, and Swedish is the language spoken in nearly all of the coast towns and in the country districts bordering on the coast. Swedish has always been the language of the upper classes, and until recent years Finnish was rarely heard except in the interior of the country and among the peasants.

The nationalistic wave that has swept over England, bringing in its wake the Welsh revival and in Germany the less creditable anti-Polish movement, penetrated even to Finland, and many patriotic Finns are now desirous of abandoning the Swedish language and replacing it by Finnish. At present the movement is a very strong one, but how long it will last and whether or not it will be ultimately successful are matters open to conjecture.

The Finnish language at present possesses no literature with the exception of the *Kalevala,* the Finnish national epic, and certain novels and stories that have been written within the present generation. The literary language is in process of formation, and every present-day writer finds it necessary to coin numberless words to designate objects unknown to the simple peasants and shades of meaning which correspond to the subtler feelings of a more complicated and cultured civilization.

We are not here concerned with the question as to whether or not it is the part of wisdom to foster a language which has 15 cases, bears little relation to any other language except that spoken by the Estish peasants of the Baltic coast, and is a far more difficult language to learn even than Russian. The supporters of the movement have, at any rate, the excellent argument in their favor that it is the native tongue of about 85 per cent of the population, and that any other language must be always, to the great mass of the people, a foreign tongue, and that a people can only attain to the highest forms of poetic and literary expression in their own native language.

BARONESS ALLETTA KORFF.

COSTA RICA—VULCAN'S SMITHY

By H. PITTIER, of the U. S. DEPARTMENT OF AGRICULTURE

FOR 15 YEARS DIRECTOR OF THE PHYSICAL GEOGRAPHICAL INSTITUTE OF SAN JOSÉ, COSTA RICA

THE earth's crust underlying Costa Rica and the whole of Central America is one of mother earth's great laboratories. The chemical work that is going on uninterruptedly deep below her glorious mountains is made evident to the inhabitants of the country by the numerous volcanoes and warm springs, as well as by the almost ceaseless upheaving of the soil, mostly in tremors imperceptible to the senses, but also occasionally in powerful and destructive commotions.

The mountains of Costa Rica are divided into two main systems. The southeastern system, which has one peak of 12,467 feet elevation, is at present without volcanoes, although its skeleton is formed mainly by old eruptive rocks. The peaks of the northwestern system, of less development and elevation, are mostly active or semi-active craters, the base of which is geologically of very recent origin. This chain begins with the conical peak of Turrialba, which rises in an uninterrupted slope from the plains

of Santa Clara, about 1,000 feet above sea-level, to the towering height of 10,965 feet. Its beautiful crater, forming a narrow, elongated basin, is constantly active, a strong current of sulphuric and aqueous vapors, mixed with sand, escaping noisily from a broad vent at its westernmost extremity. The only known violent eruption of this volcano, however, took place in 1869, when it poured forth huge quantities of stones and fine sand, the latter of which were carried by the trade-winds westward to Punta Arenas and farther away over the Pacific Ocean.

Within close proximity of Turrialba is Irazú, about 360 feet higher, and far better known on account of the facility with which it is reached on horseback from Cartago. This volcano shows three large extinct craters, and, far down on its northern slope, numerous solfataras and hot-water springs. It enjoys the undeserved reputation of being the one point from which both the Atlantic and Pacific oceans are visible at the same time—a peculiarity that in reality is shared by Turrialba and several other points of vantage along the ridge of the southeastern system. Its historical eruptions took place in 1723, 1726, 1821, 1822, 1844, and 1847, singularly enough in each instance, except the first (which began in February), during the month of May. The eruption of 1847 was simultaneous with heavy earthquakes, which were felt from Rivas in Nicaragua to the city of Panama.

POÁS, THE WORLD'S BIGGEST GEYSER

From Irazú the range continues westward until it reaches Poás, a picturesque mountain with a geyserian crater, photographed for the first time by the writer in 1888, and which seems to have shown

Photo by Prof. J. Fid Tristan, San Jose

THE WORLD'S LARGEST GEYSER: POÁS GEYSER, COSTA RICA

Geysers or hot-water volcanoes are sparsely distributed on the map of the world, and have been often studied and described. It will therefore be a matter of surprise to many readers to learn that the highest and by far the most formidable of them is not located in Iceland, nor in the Yellowstone National Park, nor in New Zealand, but in the little Republic of Costa Rica, on the northern boundary of Panama. The column of steam and water, shown in this picture, is 1,000 feet high.

A VIEW OF POÁS WHEN SIMMERING Photo by J. Fid Tristan

The intervals between the eruptions are very irregular. Prof. J. Fid Tristan, who has made several visits to the geyser at different seasons of the year, writes that he rarely saw the geyser in the same condition as on a previous trip. Sometimes it appeared entirely quiet, without an eruption for many hours; at other times it was covered with clouds, the mist being so thick that one could hardly see farther than a few feet below the edge of the crater. At other periods the eruptions were very frequent, and in some of them the column of water and steam reached several thousand feet.

Photo by J. Fid Tristan

Poás crater is more than half a mile wide. Its walls are steep and precipitous and about 800 feet deep. The geyser ejects mainly water, but sometimes ashes and mud. In this picture rising mud can be seen distinctly in the center.

of late an unusual activity coincident with the long series of quakes that have just afflicted Costa Rica.

Poás has at least two craters. The higher one on the pyramidal top of the mountain is extinct and filled by a marvelous sheet of blue, cold water, framed in an exuberant border of semi-tropical vegetation; the other crater, 1,000 feet lower, showing at its bottom a lead-colored lagoon, is surrounded by almost vertical jagged walls of gray pumice and other eruptive materials. This is a geyserian basin, the eruptions of which occur at irregular intervals of from 12 to 20 minutes or more, and with variable intensity. At times the water, which tastes like strong vinegar, is hardly disturbed; at other times a heavy column accompanied by dense clouds of vapor surges to a variable height, creating a furious tempest on the usually placid lake.

In 1889 the writer witnessed the rise of a column of muddy water about 1,000 feet in height, while in January last it attained, according to official reports, no less than 13,000 feet. Like Irazú, Mount Poás is of very easy access, and of late it has become very popular on account of the variety of its natural beauties. Before the January eruption of the present year it was not known to have had any dangerous outburst in historical times.

The volcanic cordillera of Costa Rica

THE BOTTOM OF POÁS CRATER Photo by J. Fid Tristan

ends near the southwestern extremity of Lake Nicaragua with Mount Orosí, the conical form of which denotes its igneous origin. But between it and the Poás geyser there are a number of other craters, some still in semi-active condition and the others quite extinct. Among the latter, the most conspicuous are Tenorio and Miravalles, well known to the officers of coasting vessels trading between Panama and San Francisco, because they are the beacons which indicate the position of the Gulf of Nicoya and the port of Puntarenas. We must not forget to add that the altitude of the range decreases steadily from Irazú westward, the peak of Orosí having an altitude of only 5,154 feet.

ROCKED BY EARTHQUAKES

The maximum of volcanic activity takes place at the eastern end of the range, and it is also that section of the country, just at its southern foot, between Turrialba and Poás—the so-called central plateau—that is most exposed to disastrous earthquakes. It is at the same time the most densely populated part of the whole country.

This central plateau then is almost constantly rocked by underground convulsions of variable intensity. From 1866 to 1903, inclusive, the average yearly number of recorded shocks was 34, about half of which were generally felt in San José and its immediate vicinity. The maximum number of shocks, 103, was reached in 1900, but during that year there were no very heavy quakes. Contrary to the opinion current among the natives, that these earthquake phenomena are more frequent at the beginning and at the end of the rainy season—a view formerly sustained by the writer

Photo by J. Fid Tristan

CLIMBING OUT OF POÁS

himself—there is no seasonal periodicity, the seisms being distributed almost evenly throughout the twelve months.

The quakes very seldom come singly, but mostly in groups, with one or several culminating shocks at some point of the series. In the 1888-'89 series, of which the writer made a special investigation, the phenomena began October 11, 1888, with almost imperceptible trepidations, and continued to increase until December 30, at 4.12 a. m., when a destructive shock worked havoc in San José and in the neighboring towns, and then steadily diminished, finally ending on February 18. The total number of separate shocks registered by the instrument was 45.

Notwithstanding the fact that in the minds of the highly imaginative and excited natives the volcanoes were the original cause of the disturbance, these hardly showed any unusual activity, as was made clear by a careful exploration; but this failed to satisfy the public, and the responsibility was speedily shifted to a hitherto unheard of crater, the *Cacho Negro,* which gave the investigating commissioner more trouble and headaches than all the real volcanoes and earthquakes taken together.

THE ERUPTION OF POÁS, JANUARY, 1910

In the most recent happenings, the disturbances seem to have started with a colossal eruption of the Poás geyser on January 25 last. On that day, at about 5 p. m., an extraordinary smoke-like column was seen from San José rising to a prodigious height, which the scientific commission, appointed later to investigate the volcano, estimated at no less than 13,000 feet. After reaching its higher point, the column spread into a mushroom-shaped grayish cloud, which, carried by the anti-trade winds, soon covered like an immense screen the whole valley of San José.

An hour after the first indication of the unusual phenomenon, a rain of ashes or volcanic sand began to fall in the capital, situated at about 20 miles, as the crow flies, southwest of Poás. Traveling in the direction toward the latter, it was noticed that the sand increased in quantity as well as in the size of its grains.

In the near proximity of the crater the volcanic mud was strongly mixed with stones, many of which, measuring as much as 1.3 foot in diameter, had broken in their fall thick limbs and roots of trees and penetrated deep into the ground. The geyserian crater itself had resumed its usual placidity, its eruptive manifestations even seeming to have stopped altogether.

From his practical knowledge of the usual course of events, the writer surmises that from the date of the above-described eruption there were repeated earth tremors in the surrounding region,

and these increased in both intensity and frequency up to the date of the two successive catastrophes that befell the unfortunate little Republic. Information, however, is lacking, owing to the regrettable fact that the condition and assistance of the observatory in San José are no longer what they used to be.

SHOCKS IN APRIL

On April 13, thirty-seven minutes after midnight, the population of the central plateau were suddenly awakened from their slumber to realize that everything around—the houses and their belongings, the churches, in the belfries of which the bells were madly ringing, the trees and the ground itself—was violently shaking. Without losing time even to put on the most elementary covering, every one ran to the open, and in a few minutes the streets and plazas were filled by terrified, clamoring crowds, some already discussing the probable origin of the quake, but most of them on their knees, loudly imploring the protection of the Saints.

Meanwhile the earth continued trembling, and up to 8.15 a. m. there were felt no less than 23 shocks, which, however, were of steadily decreasing intensity. Then everything was quiet again until 1.11 p. m., when there was another, apparently isolated shock, followed by two more at about 3 p. m., and again a single one a little after 10 o'clock. On April 14, 24 tremors of minor intensity were recorded, and on the 15th 12 more had been reported up to 2 p. m.; but only the first shock, at 12.37 a. m. of the 13th, and possibly the following shock at 1.07, were of a destructive character.

There was no loss of life, but in San José several public buildings were so badly wrecked as to become unfit for use, and walls of hundreds of private houses, many of them substantially built, were cracked or otherwise injured.

Cartago suffered damages of the same kind, and, moreover, the ground in its surroundings was rent and fissured at several places. The strongest shocks

THE ERUPTION OF POÁS GEYSER, JANUARY 25, 1910 (SEE PAGE 500)

The photograph was taken in San José, about 25 miles distant, by M. R. Soriano, and sent to the NATIONAL GEOGRAPHIC MAGAZINE by Prof. J. Fid Tristan, of San José.

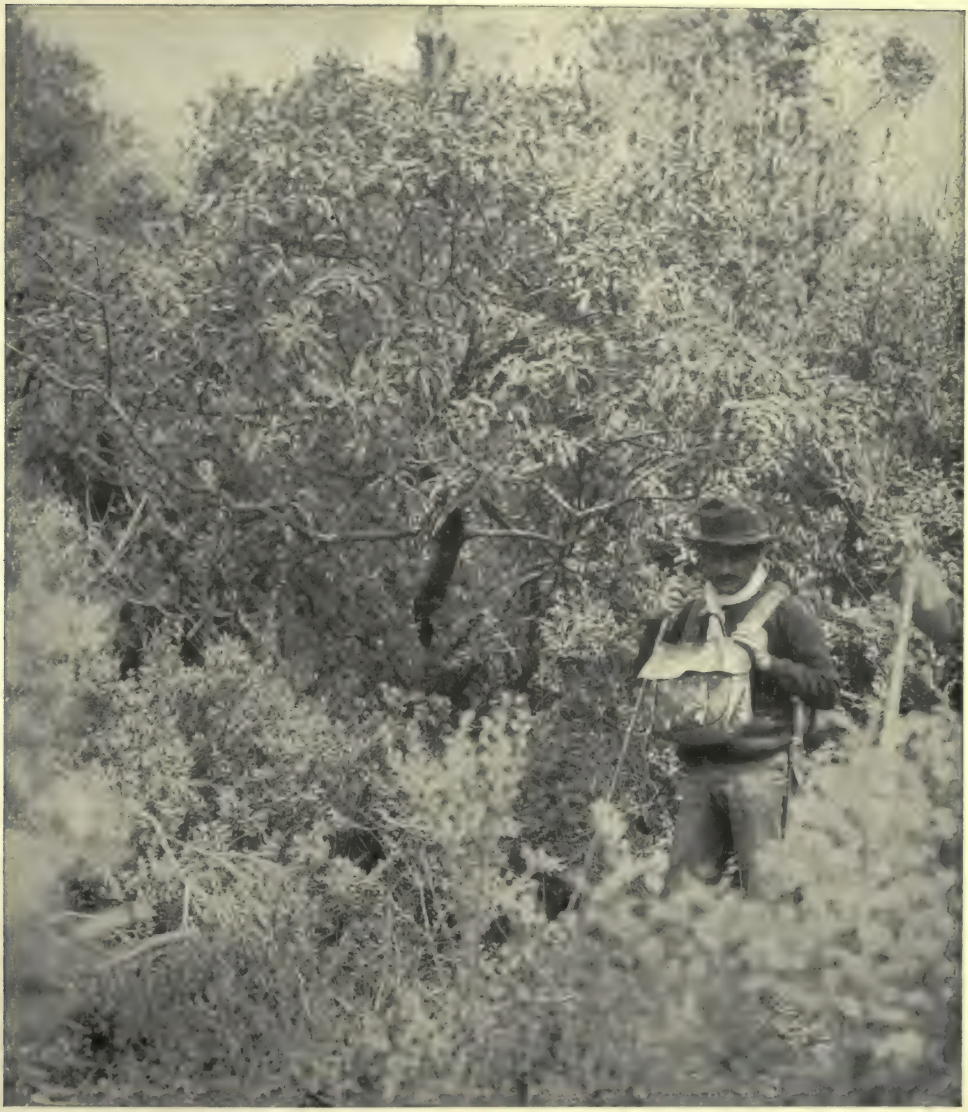
were felt along the foot of the Cordillera volcánica from Siquirres, at the eastern foot of Turrialba, to Lake Nicaragua, but they were most severe in the central plateau. In Port Limon the two first shocks only were felt, but were scarcely perceptible.

After a few days, no more seismical records were reported, though it is doubtful whether the earth tremors ceased completely. The excitement subsided, the throngs, camping in the parks under military tents and other improvised shelters, began to flock back to their usual abodes, and everybody's attention became fixed again on the coming political event, the inauguration of a new administration. This was to take place—as it did, although under the most distressing circumstances in the history of Costa Rica—on May 8.

Photo by J. Fid Tristan

A HOLE MADE BY FALLING STONE ON THE EDGE OF THE CRATER OF POÁS
(SEE PAGE 500)

Some of these holes were 3 feet deep. Note the white ashes which has shrouded the vegetation



The shower of ashes from Poás, January 25, 1910, covered the trees and shrubs for many miles around with a beautiful white powder (see page 500)

Photo from Rear Admiral F. Singer, U. S. N.

A succession of shocks during April so frightened the people of Cartago that they camped out in the parks and open places during the earlier weeks of the month. Gradually the shocks subsided and the people then returned to their houses to be overwhelmed by the terrible quake of May 4 (see page 501).

THE CATASTROPHE OF MAY 4

Meanwhile the underground forces were not inactive, even though the public ceased to pay due attention to the warnings of the seismological apparatus or these had stopped working. On Wednesday, May 4, twelve minutes after noon, a premonitory oscillation was felt at San José and Cartago; but if it again awakened the fears of the timorous ones, it was not enough to render them suspicious of the possibility of worse happenings.

At 6.50 p. m., when the early tropical darkness had sent most people home to prepare for their nightly rest, a sudden shock, coming apparently from beneath their feet, converted Cartago in an instant into an immense heap of rubbish, from which rose in the midst of deafening crashes and underground noises the death shrieks of hundreds of victims and the agonizing appeals of living ones imprisoned beneath the debris of their abodes.

A point on which most witnesses agree is the sharpness of the most destructive shock; it was followed indeed by a series of oscillations which lasted for several seconds, but the disaster was a thing of the first impulse and of imperceptible duration.

Of the people that were taken alive from the ruins, only a few had had time to follow their instinct or the inspiration of a rare presence of mind and to glide under a table or bedstead; among the dead a merchant was found with the pen still between his fingers, crushed flat upon the ledger in which he had been writing; a shoemaker lay with his arm stretched above his head, hammer in hand, as in the act of striking the sole.

No pen could picture the horror of the situation; the uninjured running about blindly through the debris, too dazed to know what to do; the electric-light plant out of commission, and every lantern in the place smashed, so that everything was wrapped in complete

ONE OF THE PRINCIPAL STREETS IN CARTAGO AFTER THE EARTHQUAKE OF MAY 4, 1910

darkness; all means of communication with the neighboring towns cut off.

DR ANDERSON'S EXPERIENCE

Dr Luis Anderson, a well-known Costa Rican lawyer and statesman, who left Washington a few weeks before, after having won for his country fair hopes of an equitable adjustment of a long-disputed boundary question, writes:

"I was just in the act of crossing the street from one sidewalk to the other when I felt something strange, like a sensation of emptiness, for the description of which no words can be found. At the same time an explosive noise, comparable to the almost simultaneous discharge of many rifles, filled the air. I shut my eyes for one second, and when I again opened them the utmost obscurity enveloped me; Cartago no longer existed. I realized that all danger of being crushed was past, since nothing had been left standing, but, at the same time, I felt as though death would come through asphyxiation. The violence of the following oscillations was such that I was thrown on the ground, where I lay stretched for a while."

Persons who were on their door-sills or walking along on the narrow sidewalk tell how they were thrown into the middle of the street, while still others who were far from any falling wall were thrown against these to a certain death.

Dr Anderson soon realized the helplessness of the stricken city, and, failing to obtain any quick means of transportation, started to walk the 10 miles to Tres Rios, about half way to San José, and which he reached a little after 10 p. m. There, after the Morse apparatus had been extracted from under the ruins of the telegraph office and reconnected, he succeeded in wiring the appalling news to the capital, which had had its share

A CHURCH IN CARTAGO, DESTROYED MAY 4, 1910

Photo from J. Fid Tristan

A HOUSE IN CARTAGO

Photo from J. Fid Tristan

A SCHOOL FOR YOUNG LADIES IN CARTAGO
The pupils and teachers were crushed in the ruins

Photo from J. Fid Tristan

A HOUSE IN THE CENTER OF THE CITY OF CARTAGO

of the calamity, although on a lesser scale.

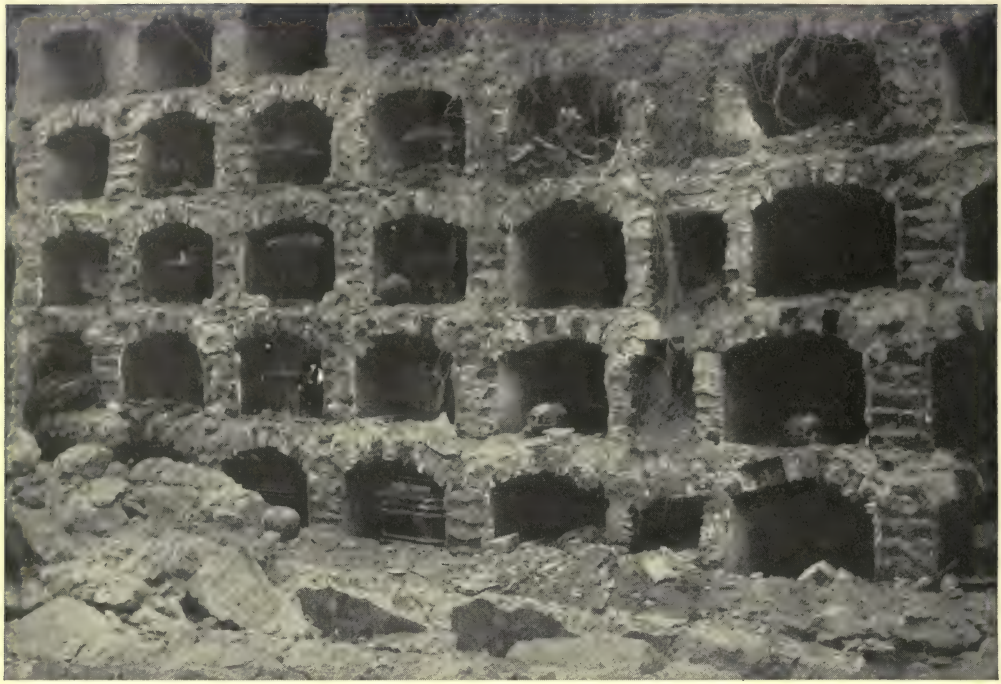
A first relief train was soon started, but at a short distance beyond Tres Rios a huge cleft in the mountain side had twisted the track in such a way as to make impossible any further progress by rail. So the little troup of physicians and other helpers, headed by the President of the Republic, had to continue their way on foot, arriving at the place where formerly had stood Cartago a little before 5 a. m., or nearly ten hours after the direful event.

Unfortunate Cartago, one of the most ancient European cities in America, has had in its past several like experiences, though none so fatal. As a consequence of the long eruption of the Irazú, accompanied by continual earth movements and subterraneous rumblings, the place was largely depopulated in 1723. It grew up again during the next century, but on September 2, 1841, it was utterly wiped out by an earth commotion of unheard of violence; the victims, however, were few, and as most buildings were very unsubstantially built of adobe and roofed with straw or tiles, the damages were of relatively little importance. So the community was again prosperous in 1851, when on May 18 it was partly destroyed by a new series of seismic disturbances.

Although it suffered less than San José from the several shocks experienced in 1888-'89, it would appear that it is located at or near the more exposed portion of the Costa Rican seismic area.

In the present case, however, the little village of Paraiso, a short distance to the east, seems to have stood on the very center; here, except for the newly erected church, the ruins of which are still partly standing, every bit of wall has been razed to the ground, while the proportion of human victims is considerably larger than in Cartago.

A few weeks ago the surrounding country was strewn with small native dwellings, most of which sheltered large families, and which also crumbled into



THE CEMETERY AT CARTAGO, SHOWING THE VAULTS BURST OPEN BY THE EARTHQUAKE

dust under the terrific blow. Today these former abodes of simple and good people look like shapeless tumuli, hiding in many instances untold victims, and all around ownerless cattle are peacefully browsing unmindful of their desolate surroundings.

FUTURE RAVAGES CAN BE PREVENTED BY BUILDINGS OF WOOD AND STEEL

The greater part of modern Cartago was very substantially built of stone and brick with roofs of tile or of corrugated iron, and mostly on the old Spanish plan; that is to say, with four sides forming a square around one or two inner *patios* or courts. There were few two-story houses, and an exceptional number of churches, none of which have been spared. As it was explained above, the principal damage was caused by the first commotion, but the falling in of the buildings that had partly resisted continued as a result of the repeated shocks, which numbered no less than 180 during the four hours directly following the initial movement.

Ninety-six squares have been completely leveled, and the few houses left standing in the remaining part of the city are useless ruins, excepting one, which was left as a practical lesson to be applied in the work of reconstruction. This is a wooden cottage, which was indeed slightly moved from its foundations and somewhat twisted, but stood the shocks well enough not to endanger the life of its inmates.

In view of the fact that Cartago, as also the whole central plateau of Costa Rica, is constantly exposed to a repetition of the same seismic troubles, it is to be hoped that the use of wooden-frame houses will become general, and that the architectonic art will develop along the cottage and bungalow lines rather than in heavy stone or adobe construction.

In the United States, under very vari-

THE TOWER OF EL CARMEN WAS HURLED MANY YARDS (SEE PAGE 513)

able climatic conditions, there are hundreds of towns twice as large at least as Cartago or even San José that are almost exclusively built of wood, and the dwellings of which are in every respect more salubrious and more comfortable than the best houses in Costa Rica. The timber supply of the little republic will be practically inexhaustible when the extensive primeval forests that still cover three-quarters of the entire surface of the country are made accessible by the means of good roads.

The only building materials to be imported would then be, as heretofore, gypsum, iron sheeting, and hardware. No objection could really be made, except those born from a long-acquired prejudice, against the radical abandonment of the cumbrous earth or stone walls and tile roofs, and of a general style of building the origin of which can be traced to the Moors of southern Spain.

Of course this system of light wooden construction is applicable mainly to private dwellings, while a more substantial style may be desirable for public and business buildings. For these structures the steel-frame combination so extensively used in the great American cities affords adequate protection. Steel edifices of two or three stories can be made absolutely earthquake-proof as well as fireproof, and should therefore be generally adopted for schools, public offices, and other establishments where large crowds congregate. San José possesses such a school building that has withstood many heavy shocks without the least damage. It has also a private 3-story steel frame and brick structure which shows very slight damage as a result of the recent catastrophe.

But the public should be protected against the ignorance of so-called architects who pretend to make walls more resistant by including in their mass light

Photo from Rear Admiral F. Singer, U. S. N.

THE CARNEGIE PALACE OF PEACE, DESTROYED BY THE EARTHQUAKE MAY 4, 1910
Mr Carnegie immediately offered to rebuild the palace

Photo from Rear Admiral F. Singer, U. S. N.

THE CARNEGIE PALACE OF PEACE, NEARLY COMPLETED AT CARTAGO, COSTA RICA, AS IT APPEARED THREE WEEKS BEFORE THE EARTHQUAKE OF MAY 4

isolated steel rails, as may be seen, for example, in the pictures of the destroyed Carnegie building in Cartago. The frames protect the structure by their almost absolute rigidity, while isolated steel rails act under the shocks like so many springs that repeat and prolong the initial oscillatory movement, only to make more certain the total destruction of the walls they were intended to strengthen.

MR CARNEGIE'S PEACE PALACE DESTROYED

Several incidents are reported that give a further idea of the nature and violence of the seismic storm. All around Cartago the innumerable rounded stones scattered over the fields by former irruptions of mountain torrents had been collected to form the inclosures around pastures and truck gardens. These walls were completely demolished by the quakes, and many of the heaviest blocks, weighing in some instances over two tons, were moved 70 to 100 feet from their original place.

The top of the southern tower of El Carmen, one of the oldest churches, which had in the past resisted many strong shocks, was detached in a single piece and hurled to the middle of the neighboring street, where it demolished the railroad track.

On the plaza in front of the church the statue of Don Jesús Jiménez, a former patriot and president, was merely transferred, without falling, from the center to one of the corners of its pedestal.

The palace built at the expense of Mr Andrew Carnegie, to be the abode of the Central American Court of Arbitration, and which was soon to be dedicated, was converted into a shapeless heap of rubbish but for its foundation and the southern front wall. The new sewerage and water systems, on the other hand, do not seem to have suffered.

Going westward the extent of the damage becomes gradually less until it is almost insignificant at Alajuela, at the

"LOS ANGELES" Photo from J. Fid Tristan

One of the richest churches in Cartago. The treasures kept in this church are worth many thousand dollars

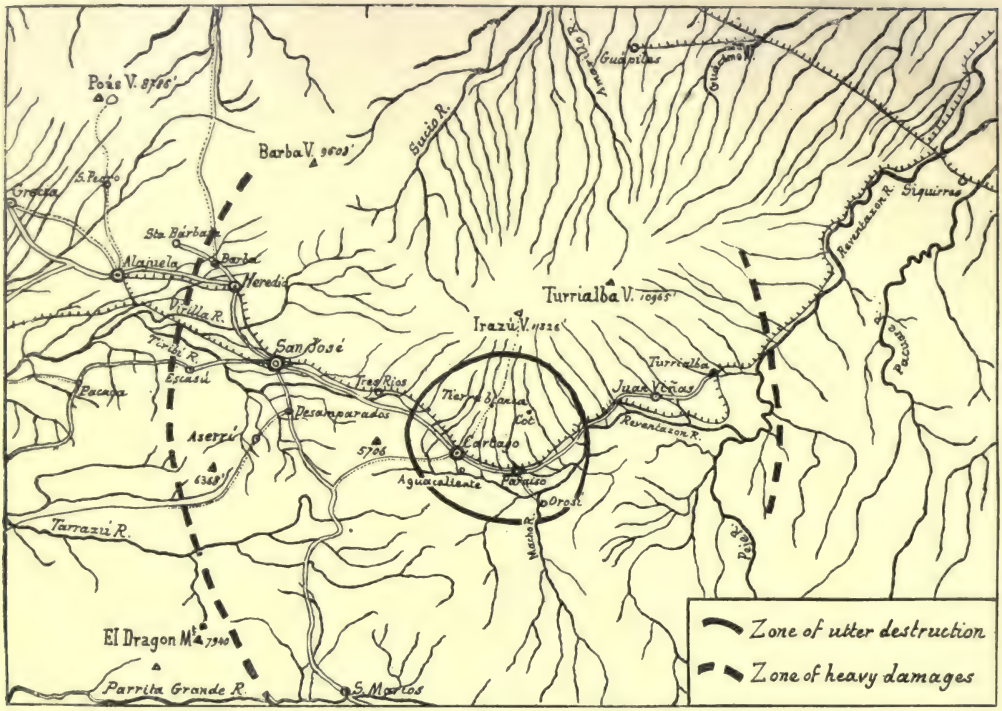
PANORAMA OF THE RESIDENCE SECTION OF CARTAGO AFTER THE EARTHQUAKE OF MAY 4, 1910

foot of the Poás Volcano. In San José the material losses have been considerable. Among the public property, the four buildings of the boys' high school are practically out of use; two other school buildings have lost their upper stories; the old presidential mansion, of late Comandancia de Armas, is a wreck; the new penitentiary building is heavily damaged, and the Supreme Court of Justice had to be evacuated. Of the private residences, it is said that 80 per cent could not possibly stand a repetition of the trial of April 13 last.

At the latest news, about May 23, seismic movements were still felt, although with a reduced intensity, and 6 to 10 shocks were reported daily. All seem to indicate, however, that the worst is over.

During the night of May 13-14 several persons affirmed having seen from San José glaring flames issuing from the volcanoes, disagreeing only as to the identity of the crater, which some called Irazú and others Poás. These two are located, as may be seen from the map, in quite opposite directions. The contradiction is now explained by the fact, attested by many people, that at the moment of the strongest shock a brilliant meteor crossed the zenith exactly from east to west, and further notices from the Pacific coast indicate that that body fell in the middle of the Gulf of Nicoya.

As a matter of fact, none of the Costa Rican volcanoes have shown of late any sign of unusual activity, and the current notices about lava eruptions and the formation of new craters should be accepted with caution.



MAP OF THAT PART OF COSTA RICA WHICH WAS OVERWHELMED BY THE EARTHQUAKE OF MAY 4, 1910, BY H. PITTIER

As usual on such occasions, many instances of miraculous rescues are cited, and a large number of persons at first thought to have perished turned up safe and sound. Nevertheless, the ruins of the old city had already given back over 600 bodies at the date of our latest information, and many more will remain to rest awhile under the débris, lucky if death came instantly and not, as it has been found in several cases, after hours of excruciating agony.

In Paraiso, over 120 dead have been removed from the ruins, and, if the casualty lists of Aguacaliente, El Tejar, Tierra Blanca, Cot, San Rafael, and other villages and hamlets or isolated houses are added to the former, the total number of the victims will certainly reach far above 1,000. Besides, it is feared that many of the 500 or 600 patients filling the hospitals in consequence of the earthquakes may not recover.

The material losses, reaching a sum well up into the millions, may not seem very great to an American, but they are simply crushing to a little country like Costa Rica, especially at the present time, coming upon her as it has in the most serious and trying financial crisis she has ever experienced in her history.

THE PEOPLE OF COSTA RICA ARE VERY DIFFERENT FROM OTHER CENTRAL AMERICANS

The sympathy of the American people and of all civilized nations will certainly go out to the unfortunate little Republic, which is attractive not only on account of its natural beauties, the richness of its flora and fauna, the striking contrast between its warm and fruitful coastal plains, which yield yearly millions of bunches of bananas, and its picturesque mountains, producing coffee of the very finest quality, as well as nearly every

product of the temperate zone, but also because of the history of the past half century of steady fighting, not bloody and cruel, nor for power, nor for the satisfaction of petty ambitions, but for the conquest of knowledge and the enlightenment of its citizens.

For Costa Rica stands alone among the turbulent Central American States in all things pertaining to freedom, self-government, and progress. The country was colonized at first by people from the ancient Spanish province of Galicia, and the colonists have not, as in many tropical countries, amalgamated with the aborigines; they have consequently kept to the present time the original characteristics, as well as the qualities of their race, and the inherent grace and charm of their ancestors. They are laborious, progressive, and peace-loving, and have a record of a long period of absolute internal tranquility.

Three-quarters of the population inhabit the so-called Central Plateau, the climate of which is the most perfect realization of perpetual spring. The agriculture of this region is very highly developed, the principal product being coffee, maize, beans, and potatoes. The land is divided into exceedingly small holdings. Almost every peasant is a land-owner.

The Atlantic coast, warm, humid, and rather unhealthful, but very fertile, produces on a very large scale bananas and cacao, the exploitation of which is unfortunately tied by contracts with foreign companies. In the banana plantations, covering over a hundred square miles, the laborers are mainly West Indian negroes, the only human beings able to stand hard and continuous work under the climatic conditions.

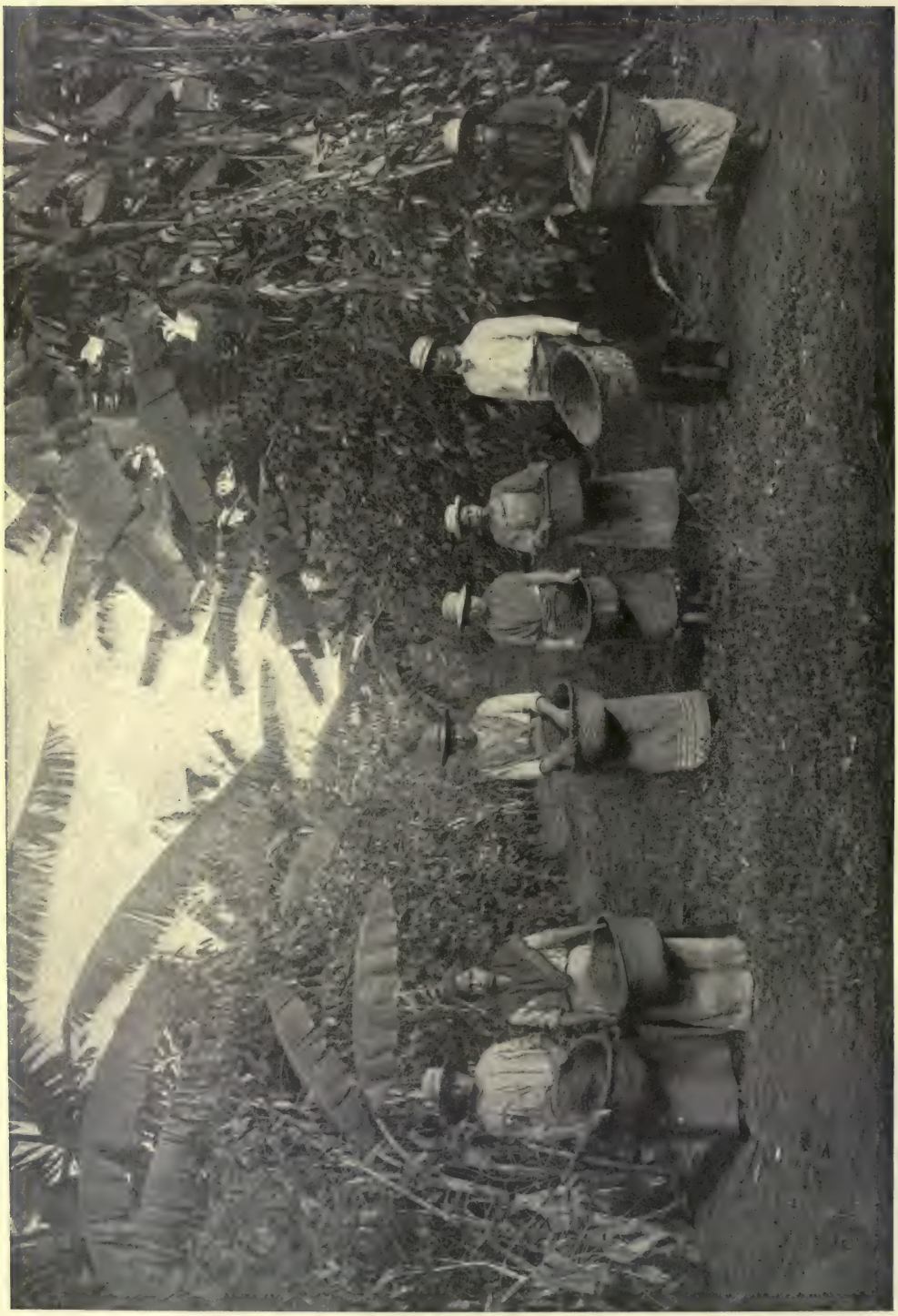
The Pacific coast does not differ much from the interior but for its warmer temperature and its extensive grass-covered savanas, in which stock raising is the chief industry.

Except for a small part, located in the western province of Guanacaste, the 360,000 inhabitants are crowded into a narrow belt extending across the country from Ocean to Ocean, along the railroad which connects Port Limon and Punta Arenas. The remaining part of the State—that is to say, four-fifths of its entire surface of about 18,400 square miles—is a wilderness, with but a handful of hardly half-civilized Indians inhabiting the valleys of Diquís and Talamanca.

Of the five Central American Republics, Costa Rica was the first to be connected by a railway with the eastern coast, thus getting into close touch with European civilization. In many respects this was a source of real benefit to the country. The Costa Ricans became great travelers. They sent their sons to be educated in foreign schools and universities, and on their return these diffused among their fellow-citizens new ideals and more advanced moral standards. Foreign teachers and professors were brought and kept long enough to establish on a solid foundation an excellent school system, so perfect indeed that illiterate men or women are hard to find, while books and newspapers are common even in the most remote hamlets. The scientific study of the climate and the natural resources of the country was carried on at the expense of the government, and the introduction of modern arts and agricultural methods and implements were given every encouragement.

Sad to say, the uplift in the general education has awakened misdirected ambitions among the poorer classes, attracted the peasants to the cities, created a greed for government positions, these having consequently multiplied beyond all reasonable limits, with a corresponding and necessary increase of public expenditures.

Moreover, on account of a heavy public debt, the result, partly of unscrupulous speculations of foreign and native financiers and of unwise undertakings, the government has become entangled in heavy financial difficulties that have brought the country to the verge of bankruptcy. This deplorable economic situation has been aggravated of late by



A COFFEE PLANTATION IN COSTA RICA

Banana trees protect the coffee bushes from the intense rays of the sun

Photo by Rev. Grinter

PICKING COFFEE, COSTA RICA

Photo by Rev. Grinter

BANANA PLANTATION OF THE UNITED FRUIT COMPANY AT CHIRRIPÓ, NEAR PORT LIMON Photo by H. Pittier

Zent River in the foreground, Chirripó River and last spurs of the Cordillera in background

Photo by H. Pittier

SHIPPING THE BANANAS, COSTA RICA

POLISHING A LARGE JAR WITH A STONE

THE KILN FOR BAKING SMALL PIECES

Photos by H. Pittier

MAKING POTTERY IN COSTA RICA

MODELING

BAKING A LARGE POT

Photos by H. Pittier

A STREET OF NICOYA, A PACIFIC COAST VILLAGE

NATIVE CART, COSTA RICA

Photos by H. Pittier

several consecutive failures of the coffee crop, by unusual rainy seasons, resulting in inundations, destruction of railroads, and depression of the banana trade.

A catastrophe like that which has just befallen Costa Rica is appalling enough whenever it occurs, but it could not have come at a more unfortunate time in the life of that interesting spot of the American Tropics.

THE ERRATIC

By O. A. Ljungstedt, of the U. S. Geological Survey

WHENEVER your vacation rambles have taken you to one of the Northern States of the country, you have no doubt often been struck by the sight of some unusually large boulder perched on the top of a mountain, or resting, maybe, in such a nicely balanced position by the very edge of the sea that a dashing wave may rock it to and fro.

Examine one of these boulders more closely and you will find several things to distinguish it from others that you may have noticed south of the area shown as white in the map on page 526. Should the rock on which the boulder lies be bare of soil, it will often be found to be of a different kind than that of which the boulder is composed. Thus the boulder itself may be of granite and rest on a surface of limestone, shale, or sandstone.

You will also often find this bare rock polished to a remarkable degree, or marred by scratches, and even deep grooves running in a more or less parallel direction, known as glacial striæ.

To understand how a block of granite as large as a small cabin could be lodged on top of a mountain when there is no similar rock within a hundred miles or more, we must trace its history back to a time at least 200,000 years ago, when the geologic period called the Tertiary was drawing to its close. The first fact to attract our attention, could we have taken a bird's-eye view of the northern part of our continent at that time, would be its greater extent than at present. Looking eastward we would see the shoreline extending in places a hundred miles beyond the shoreline of today, and in vain would we scan for the islands, bays, and reaches that now lend such enchantment to our picturesque coast.

Northward the land probably stretched unbroken over the present Arctic archipelago, and connected on the east by way of Greenland, Iceland, and the Scandinavian Peninsula with Europe and on the west by closing of Bering Strait with Asia.

This circumstance had a very important bearing on the fauna of that day, as it enabled the animals from the one continent to cross to the other. Making a closer inspection of the landscape beneath us, we would be surprised at the total absence of the smaller lakes that now are its most characteristic feature. Even the Great Lakes were missing, with the possible exception of Lake Superior, while in the valleys in which these latter now lie flowed rivers belonging to one or more systems.

The mountain groups of today we would recognize at once, notwithstanding their somewhat more rugged outline, and the same would be true in the case of the rivers. While we would see a number of them in strange courses, the master streams we would know at first glance. For millions of years these had been cutting their channels undisturbed, until at the close of the Tertiary a new impetus was imparted to them, owing to the recent rise of land and the ever-increasing humidity of the climate. So we would probably see them turbulent and swollen and the sides of their water-courses often precipitous and jagged, overhung in

MAP OF NORTH AMERICA AT THE TIME OF MAXIMUM EXTENT OF THE ICE

Showing also the approximate outline of the continent. There were minor ice-centers, not indicated, over most of the high mountain ranges of the west from which glaciers descended the valleys and in some places deployed on the plains.

places by great ledges and loose blocks readily dislodged by the least force.

The climate over the whole continent was semi-tropical, or at least temperate, and such plants as the fig and great redwoods of California grew as far north as Greenland and Iceland. And through the almost endless woods of the north roamed herds of mastodon and other herbivore of great size, together with such beasts of prey as the now extinct saber-toothed tiger. But we would find no trace of man.

Over this strange and magnificent world the Ice Age swept down so suddenly, as geologic time is reckoned, that

A VERY REMARKABLE CASE OF ONE ERRATIC SUPERIMPOSED ON ANOTHER

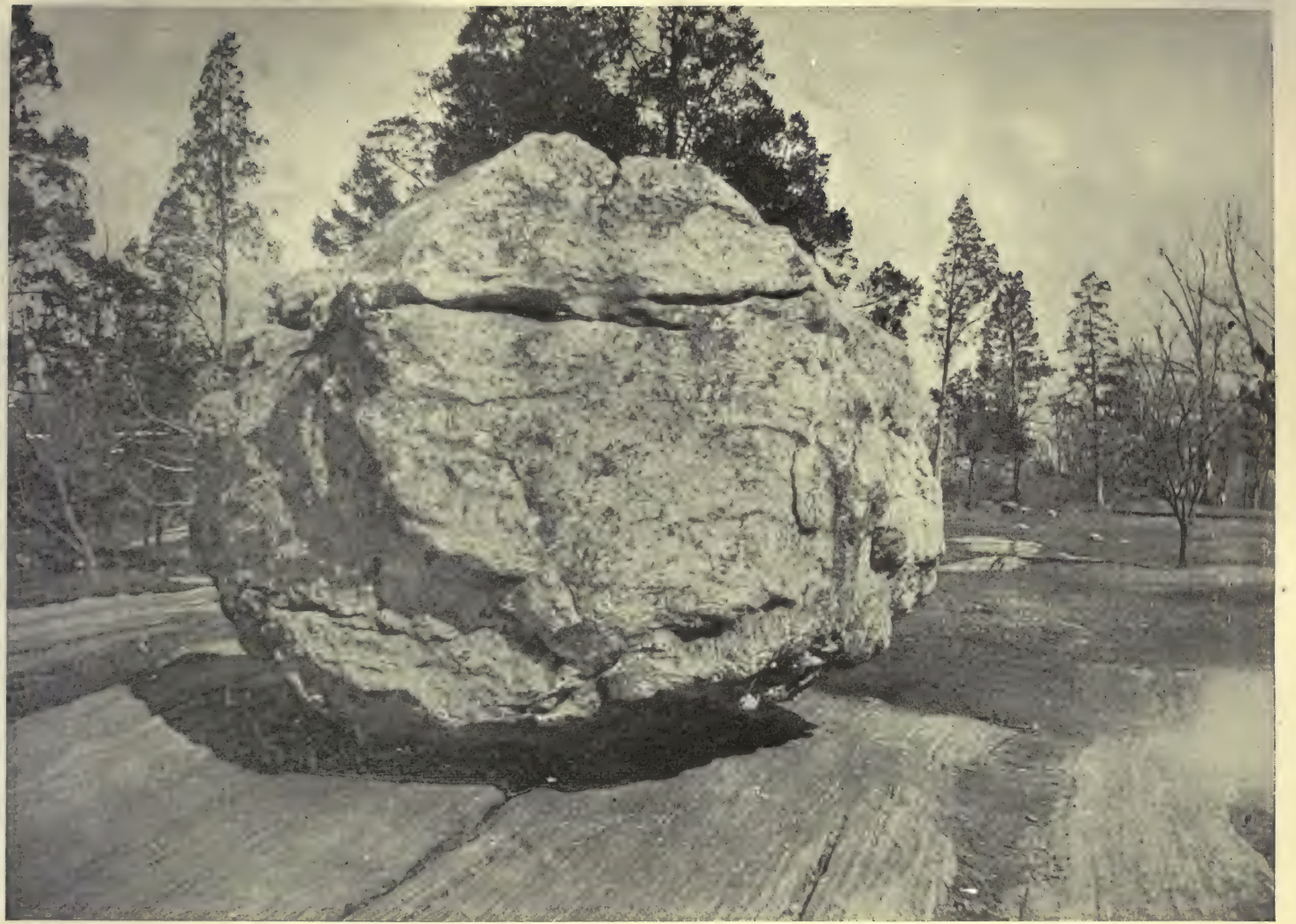
The upper one of coarse granite, the lower one of granite gneiss resting on a granite ledge. They are situated at Sunnyridge farmhouse, 3 miles west-northwest from Barre, Massachusetts. From photo by Mr. C. W. Alden, of the U. S. Geological Survey.

THE WASHINGTON BOULDER NEAR CONWAY, NEW HAMPSHIRE

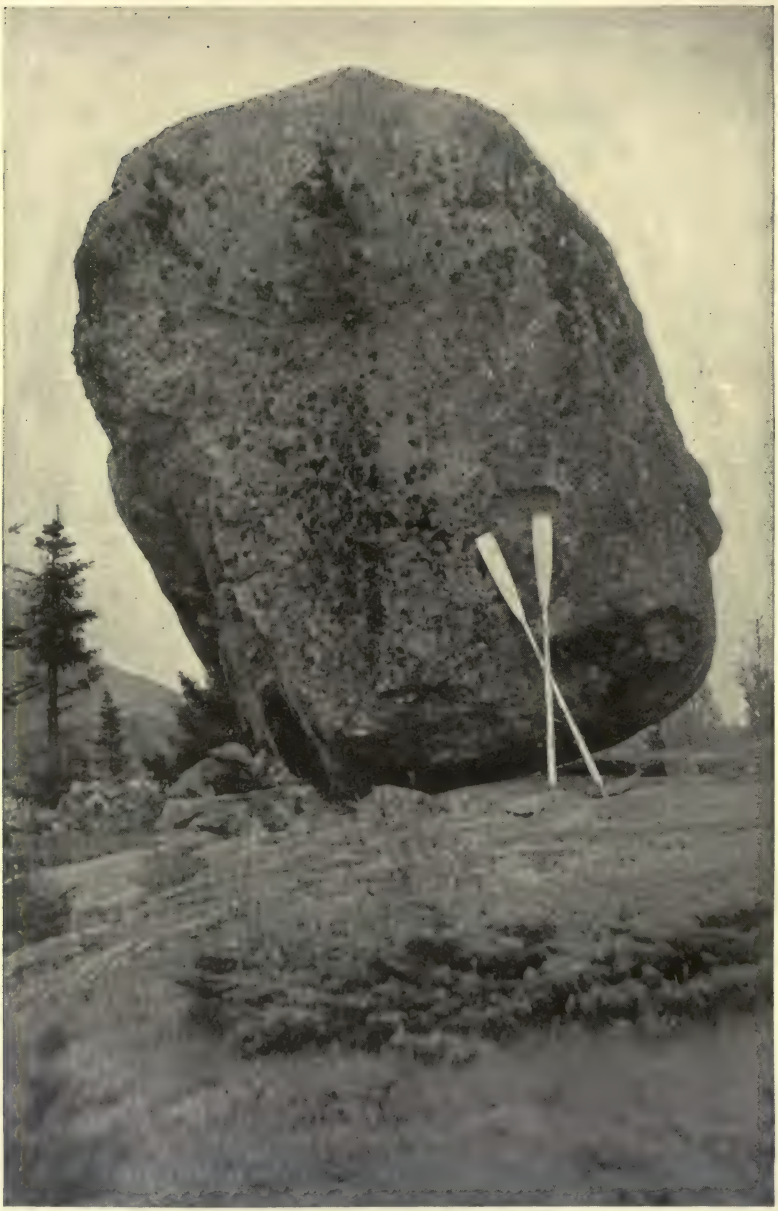
From negative in possession of the Geological Society of America

BOULDER ON GLACIATED SURFACE NORTH OF BLOODS, CALIFORNIA

This is the work of glaciers descending the valleys from one of the local ice-centers south of the continental cap. From photograph by H. W. Turner



An erratic often lies on a smooth and striated surface as does this one in Bronx Park, New York City. The grooves show the direction in which the ice moved. From negative in possession of the Geological Society of America



BOULDER AT SOUTHWEST END OF MEGUNTICOOK LAKE, WEST OF CAMDEN, MAINE

From photo by E. S. Bastin, of the U. S. Geological Survey

most of the then existing animal and plant forms, pushed south before its advance, had not time enough to adapt themselves to their new environment, and therefore became greatly altered or exterminated.

As yet there has been no good reason assigned for a change that in a comparatively short time transformed the semi-tropical climate into that of Greenland of today. Probably a combination of circumstances brought it about.

Be that as it may, the fact remains that over certain centers—one on the east of Hudson Bay, the Labradorian; another on the west of it, the Keewatin; and a third in the Canadian Rockies, the Cordilleran — snow, gradually changing into ice, accumulated year after year to such immense thicknesses that finally, impelled by its own weight, motion began, and three giant glaciers crept out over the adjacent country. These finally joined into a continental ice mass that at its greatest extent covered two-thirds of North America—an area of about 4,000,000 square miles.

While there may have been some difference in time at which the various ice centers reached their greatest development, we will be very near the truth in saying that from the southern limit, shown on the map, northward the ice lay in one unbroken expanse, with the exception of the so-called Driftless Area and possibly one of the highest mountain peaks in the East. It is calculated that its thickness at the two eastern centers must have been something like 5,000 to 10,000 feet.

On its way from the north the ice mass gathered to itself immense quantities of soil and loose rock, which were carried along with it. Occasionally huge blocks of rock from mountain slopes and stream bottoms were clutched in the firm grip of the ice and carted for hundreds of miles. Frequently the ice would lift great boulders from the bottom of a valley to the top of a mountain.

Presently the ice began to retreat before a more congenial climate. It was not at first, however, a steady retreat, as not less than four times the ice again advanced after having almost vanished, and each time it was followed by animals and plants adapted to the semi-frigid climate at its edge. During one of these interglacial epochs man appeared upon the scene.

But as the ice melted and disappeared the earth and rocks which it carried were dumped, sometimes as an even mantle, but more often in hills and ridges.

A PRIMITIVE GYROSCOPE IN LIBERIA

By G. N. Collins

THE recent applications of the gyroscope in the Brennan monorail and as a means of steadying steamships, as well as the present popularity of toys based on this principle, recall a gyroscopic toy in use among the Golahs of Liberia, West Africa. Certain members of this primitive tribe have developed a very remarkable skill in manipulating this top-like toy, which they keep spinning for any length of time in midair merely by whipping it.

Interest in this primitive gyroscope has been further increased by the botanical identification of the fruit from which the tops are made. Mr W. T. Swingle, of the Department of Agriculture, points out that these hard-shelled, spherical fruits belong to the genus Balsamocitrus, a very near relative of the ball fruits of India and a more distant relative of the orange.

These fruits may well be described as hard-shelled oranges (see page 532). They are from three to five inches in diameter. The shell is very hard and from one-quarter to one-half inch in thickness.

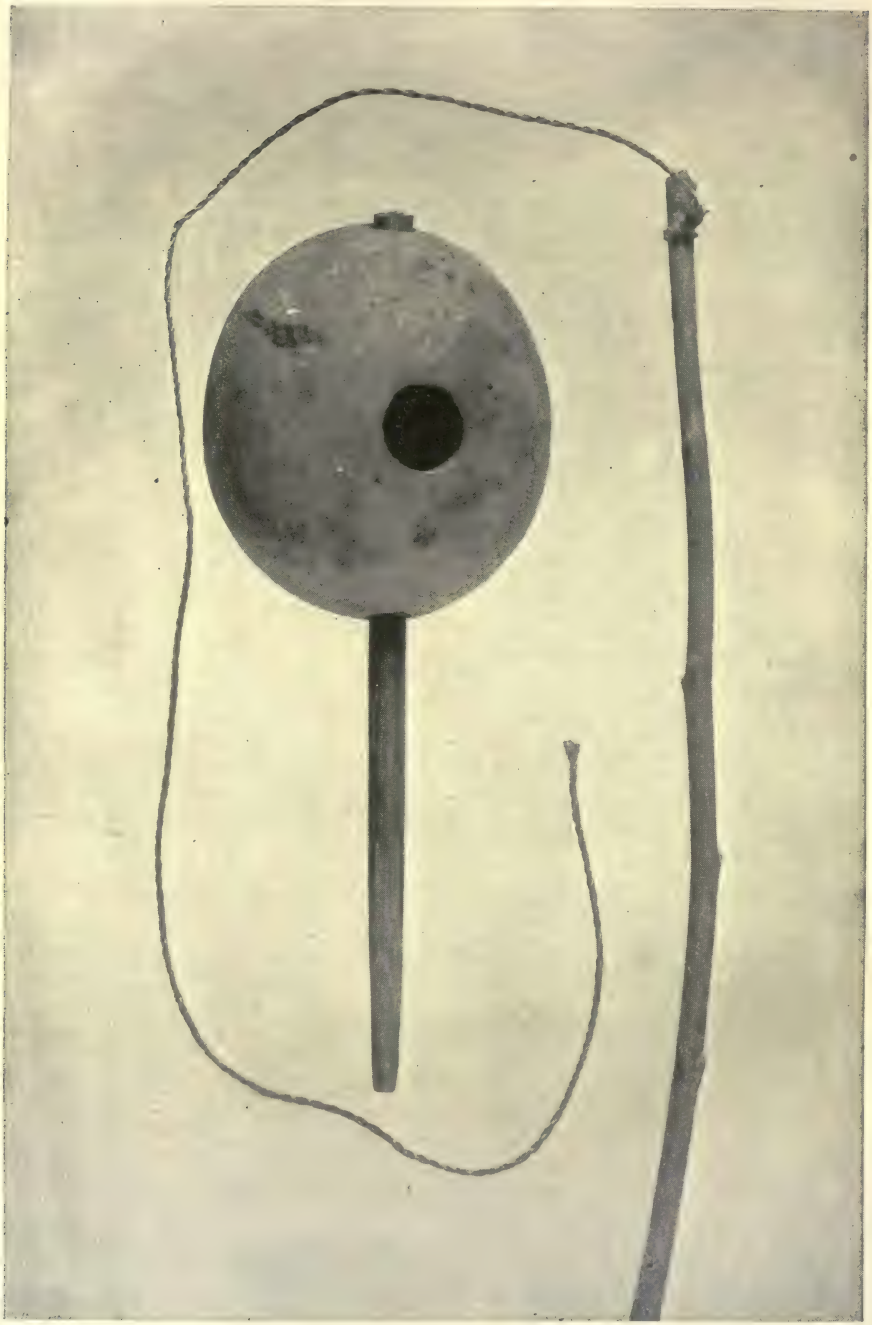


Photo by G. N. Collins

LIBERIA GYROSCOPIC TOP, MADE FROM THE FRUIT OF A HARD-SHELLED ORANGE

The top is made to spin rapidly in midair by the aid of the whip

Photo by G. N. Collins

METHOD OF STARTING THE GYROSCOPIC TOP

The lash of the whip is wound around the body of the top. A sudden upward motion throws the top into the air and starts it revolving

Photo by G. N. Collins

LIBERIAN NATIVE SPINNING THE GYROSCOPIC TOP

The top can be seen in the air above the Golah man's head. The top is kept in the air by repeated strokes of a small whip

The top is formed of one of the fruits from which the interior has been removed, together with a round stick about one-half an inch in diameter and eight inches in length. The stick passes through the center of the fruit, projecting only on one side. A hole is also cut in the side of the fruit so that the top produces a low, mournful sound when spinning rapidly.

The whip by means of which the top is kept in the air consists of a stalk about one foot in length to which a string about 18 inches long, made from the fiber of the wine palm, is tied as a lash.

The method of starting the top is shown on page 533. The lash of the whip is wound around the body of the top, making a little more than one turn. The top is then placed on the ground with the stem to one side. The whip is given a quick upward motion, throwing the top into the air at the same time, imparting to it a spinning motion. As the top drops within reach, but before it touches the ground, it is struck with the whip in such a manner that the lash winds around the stem close to the head. The stroke is immediately followed by another upward motion, which again throws the top up and makes it revolve still faster.

This operation is repeated rapidly, the top going faster and faster with each stroke, until it begins to emit a low musical note. The illustration on page 534 shows the top in the air.

The performance may be likened to the operation of the popular toy called "diablo," but the skill required is immensely greater. The "diablo" is thrown up from the middle, and the ends on either side of the string, being of equal weight, balance each other, while in the Liberian toy the weight is practically all on one side of the place struck by the whip.

Skilled performers have no difficulty in keeping the top in the air for any length of time desired. The performance is varied by catching the top on the stock of the whip and slowly tilting it until the end of the stick rests on the ground, where it spins for some time like an ordinary top. From this position, while still spinning, the top can again be thrown into the air by the whip and the whole operation repeated.

When first seen it seems incredible that the top can be thrown up by the stem, which is on one side, without twisting the top into another position. There can be no doubt that the same principle is involved as when a gyroscope is maintained in a horizontal position, although supported by only one end of the axis.

The skill required to operate this top is possessed by very few members of the tribe. Repeated and patient efforts on my part to acquire the knack were futile. I was never able to keep the top in the air for more than two or three strokes of the whip, and was never able to make it revolve fast enough to produce a sound.

Bwingba, the Golah man who is shown operating this top in the illustration, was the only native I met who possessed the necessary skill. That this man had more than ordinary ability was shown in other ways. His house was the best in the town, he could swim faster and dive farther than any one else, and he was always chosen for the dangerous work of taking the big canoes from the upper reaches of the Saint Paul River through the rapids to the lower river. This skill in aquatics was supposed to be explained by his having a hippopotamus for a totem.

The sound produced by this top is believed by the Golahs to be distasteful to the ground hogs, which often do considerable damage to cultivated fields. This means of driving away pests is considered so effective that men able to perform with this top are in great damand, and are often called a distance of two or three days' travel to rid fields of these pests.

EUROPEAN TRIBUTES TO PEARY

ALL the nations of Europe united to give Commander Peary a royal welcome on his visit to England and the Continent in May and early June. Emperors and kings, scientists, the public, and the press were all equally cordial and enthusiastic in their congratulations and tribute to his perseverance and success.

Commander Peary's trip was not a lecture tour, but was made in response to many invitations from geographical and scientific societies abroad who desired to hear his personal story of the discovery of the North Pole. It was impossible in the brief time to accept the invitations of all the societies, but eleven capitals were visited. Commander Peary gave his first European address in London before the Royal Geographical Society, which provided an enthusiastic audience of 10,000 people. The illness of King Edward prevented his attendance, and his death a few days later also prevented the presence of Emperor William at the Beriin lecture.

Every Society conferred its highest honors upon Commander Peary, in Rome the King Humbert Gold Medal of the Royal Italian Geographical Society being presented in person by the King of Italy. In Edinburgh, besides receiving a special trophy from the Royal Scottish Geographical Society, the degree of LL.D. was conferred upon him by the old University of Edinburgh.

We print below the addresses of the Presidents of the Royal Geographical Society of London and of the Geographical Society of Berlin, which are typical of the unanimous respect and tribute paid in Europe to our great American explorer.

ADDRESS OF THE PRESIDENT OF THE ROYAL GEOGRAPHICAL SOCIETY OF LONDON; DR LEONARD DARWIN, IN PRESENTING THE SPECIAL GOLD MEDAL OF THE SOCIETY.

"Commander Peary was awarded our gold medal twelve years ago, which is sufficient proof that he is an Arctic traveler of the highest reputation, and his efforts have been marked by such splendid persistency as to make success appear to be the inevitable result.

"An exceptionally capable committee of his fellow-countrymen, appointed by the National Geographic Society of America, have examined his original records, and have emphatically indorsed his claim. This judicial task could not have been more appropriately placed.

"It is on these grounds that, armed with the full authority of the Council of the Royal Geographical Society, I welcome Commander Peary as the first and only human being who has ever led a party of his fellow-creatures to a pole of the earth.

"We are not alone concerned with that aspect of Arctic exploration, for, in the course of the many arduous journeys, full of dangers and difficulties, which explorers have made when dragged northward by the lodestone of the Pole, a large amount of scientific work has been done and geographical knowledge has been greatly increased. Commander Peary's expeditions form no exception to this honorable record, and this should not be forgotten, because it has been the policy of the Society not to honor any mere race for the pole."

DR ALBRECHT PENCK, PRESIDENT OF THE GEOGRAPHICAL SOCIETY OF BERLIN, IN PRESENTING THE NACHTIGAL GOLD MEDAL OF THE SOCIETY.

"The members of this meeting have just stated by their great applause what living interest they take in the speaker's report of his expedition of the North Pole. This interest is based in the first place on the sentiment which President Roosevelt expressed when giving to our speaker, three and a half years ago, the Hubbard Medal of the National Geographic Society of America. He mentioned at that time that the firm basis of successful national characters are the fighting qualities of mankind, but that these qualities could not only be demonstrated in war, but also in peace, and that

THE SILVER SHIP WHICH WAS PRESENTED TO ROBERT E. PEARY BY THE ROYAL SCOTTISH GEOGRAPHICAL SOCIETY OF EDINBURGH, MAY 24, 1910

The ship is made entirely of silver, and weighs over 100 ounces. It stands about two feet in height and is mounted on four wheels. This Society had awarded its silver medal to Commander Peary in 1897 for crossing the ice cap of Greenland, and its gold medal to him in 1903 for his Arctic explorations during the preceding four years (see page 540).

Courtesy New York Times. Copyright, 1910

1. The Gold Medal of the Imperial Austrian Geographical Society, Vienna.
2. The Gold Medal of the Royal Belgian Geographical Society, Brussels.
3. The King Humbert Gold Medal of the Royal Italian Geographical Society, Rome, which was presented by the King of Italy.
4. The Gold Medal of the Royal Geographical Society of Antwerp.

Courtesy New York Times. Copyright, 1910

1. The Special Gold Medal of the Royal Geographical Society of London, designed by the wife of Captain Robert F. Scott, R. N., leader of the British South Polar Expeditions of 1901–1904 and 1910–1912.

2. The Nachtigal Gold Medal of the Gesellschaft fur Erdgunde of Berlin (Geographical Society of Berlin).

3. The Gold Medal of the Hungarian Geographical Society, the first and only gold medal ever awarded by this Society.

THE NATIONAL GEOGRAPHIC SOCIETY TO COMMANDER ROBERT EDWIN PEARY FOR THE DISCOVERY OF THE NORTH POLE APRIL 6 1909
DECEMBER 15 1909
A SPECIAL MEDAL AWARDED BY
COMMANDER ROBERT EDWIN PEARY

THE SPECIAL GOLD MEDAL OF THE NATIONAL GEOGRAPHIC SOCIETY, PRESENTED TO COMMANDER PEARY DECEMBER 15, 1909

The medal is four inches in diameter

it is of a special value to effect such qualities during a time of peace, when naturally a tendency to a weakening of the audacious powers is evident.

"We are sure that Commander Peary is one of those heroes disposed to fight, who, with never tiring activity and perseverance and using all their powers, are pushing forward in order to attain a great and difficult aim. But we feel more than that; we think of the enlargement of our knowledge of the globe, due to his courageous deeds.

"The New York Chamber of Commerce, which appointed him honorary member, was right in saying that the success of his last expedition was based neither on luck nor on bravery nor patience, but on experience, gathered by him during a man's life of ardent labor devoted to the exploration of the North Pole. Considering these merits, we celebrate not only the hero who reached the pole, but also the explorer who discovered a great part of the polar regions."

THE SILVER SHIP

At Edinburgh, at the conclusion of the address to the Royal Scottish Geographical Society, Lord Balfour of Burleigh presented to Commander Peary a silver model of a ship such as was used by illustrious Arctic navigators in the olden times. The ship is a copy of a three-masted vessel in full sail, such as was in use in the latter part of the sixteenth century. The model is a beautiful specimen of the silversmith's art. On one of the sails is engraved the badge of the Royal Scottish Geographical Society, while another bears the inscription in Latin from the pen of Mr W. B. Blaikie, which, translated, is as follows:

"This model of a ship, such as was used by John Davis, Henry Hudson, and William Baffin, illustrious Arctic navigators of the olden time, has been presented by the Royal Scottish Geographical Society as an evidence of its congratulation, admiration, and recognition to Robert Edwin Peary, American citizen, an explorer of the frozen Arctic, not less daring than his daring predecessors, who was the first to attain to that thrice-noble goal so long sought by innumerable bold mariners, the North Pole. Edinburgh, May 24th, 1910."

BOOK REVIEWS

Japanese Goldfish. By Dr Hugh M. Smith, Deputy U. S. Commissioner of Fisheries. Many illustrations and 10 colored plates. Washington, D. C.: W. F. Roberts & Co. Price, $2.00 *net.*

Dr Smith, well known to the readers of the NATIONAL GEOGRAPHIC MAGAZINE, is one of the world's foremost authorities on fishes, and his volume on Japanese Goldfishes is the result of a close study of the subject and will be regarded as an authority. The plates of the goldfish are splendid reproductions in natural colors and the book can be recommended in the highest terms. J. O. L.

The Gateway to the Sahara. By Charles Wellington Furlong. Pp. 300, 6½ x 8½. 35 illustrations and 3 maps. New York: Charles Scribner's Sons.

By word and picture the author, a well-known traveler, gives an insight into the most native of the Barbary capitals, its odd and fascinating customs and industries, and a view of those strange and interesting people who inhabit Tripolitania. It was Mr. Furlong who, in 1904, discovered the wrecked hull of the United States frigate *Philadelphia* below the waters of Tripoli harbor, and the book gives the dramatic episode of the vessel's destruction and finding a hundred years later.
J. O. L.

London Town, Past and Present. By W. W. Hutchins, with a chapter on the Future of London by Ford Madox Hueffer. 2 vols. Pp. 1130, 8¼ x 8½. Several hundred illustrations. New York: Cassell & Company. Price, $6.00 *net.*

No work of greater importance, or one more likely to hold a permanent place, than "London Town, Past and Present," has yet been published. It is unique, comprehensive, and of marked value. It limits itself to no one period of time or to no one part of the capital, and discusses no abstruse or antiquarian questions. It recounts in vivid language all the important and arresting events from Roman times to the present day. Mr. Ford Madox Hueffer, in a clever and suggestive chapter, essays to lift a corner of the veil behind which is hidden the future of London, and presents, in characteristically rich and pregnant diction, some ingenious speculations on that theme. J. O. L.

Women of All Nations. Edited by T. Athol Joyce and N. W. Thomas. 2 vols. Pp. 772, 8¼ x 8½. Several hundred illustrations and series of color plates. New York: Cassell & Co. Price, $12.00 *net.*

"Women of All Nations" is an authoritative work by such men as the late Prof O. T. Mason, Dr Grumberg, Archibald Colquhoun, and others, being a record of the characteristics, habits, manners, customs, and influence of women ranging from the toilette of the Parisienne down to the scanty skirt of the Fijian belle. The volumes give in word and splendid picture the psychological characteristics of the women of every race. You may read how the gentler sex of China, Samoa, India, or Sweden live and work, together with their curious forms of courtship and marriage. The volumes are illustrated with a collection of rare photographs gathered from every part of the world.
J. O. L.

Hunting In British East Africa. By Percy C. Madeira. Pp. 290, 6½ x 9. 130 illustrations and 2 maps. Philadelphia: J. B. Lippincott Co.

A very interesting narrative from the pen of a big game hunter telling of his experience in that sportsman's paradise, British East Africa. Starting with the initial arrangements for the big game hunt, the reader is taken step by step through the wildness of jungle and plain into the heart of the animal kingdom and hardly realizes the study of natural history he is absorbing so graphic is Mr. Madeira's story. The illustrations, actual photographs, are very fine and the maps comprehensive. J. O. L.

Wanderings In the Roman Campagnia. By Rodolfo Lanciani. Pp. 370, 7½ x 9½. 112 illustrations. Boston: Houghton, Mifflin Co.

Camp and Camino in Lower California. By Arthur Walbridge North, with introduction by Rear Admiral Robley D. Evans, U. S. N. Pp. 346, 7⅛ x 9⅛. 32 illustrations and 2 maps. New York: The Baker & Taylor Co. Price, $3.00 *net.*

A book of adventure and exploration in Lower California, a land of desert and mountains. Few regions on the globe are less known than this country at our very door. The volume contains much that is fascinating along the lines of hunting and adventure, at the same time giving valuable description and records of scientific exploration. J. O. L.

The Great Pacific Coast. By C. Reginald L. Enock. Pp. 356, 6¼ x 9. 63 illustrations and several maps. New York: Charles Scribner's Sons. Price, $4.00 *net.*

The book from the pen of this well-known writer on Latin American subjects is rather unique, treating as it does for the first time of the vast region of the Pacific Coast of North and South America as a physical and political entity. Seen from the viewpoint of an experienced traveler, the subject is one of great interest, and especially fine are the photographic illustrations. J. O. L.

Soil Fertility and Permanent Agriculture. By Cyril G. Hopkins. Pp. 650, 6 x 8½. Numerous maps and tables. Boston: Ginn & Co.

The book is written primarily for American land-owners, who must either think and plan for the preservation of the land or allow its

more extended ruin, and secondarily for other students of agriculture and economics, whether in the lecture-room or in the business world.

Geographical Essays. By William Morris Davis. Edited by Douglas William Johnson. Pp. 777, 8 x 5½. Boston: Ginn & Co. 1909.

This is a reprint, in permanent form, of certain of the geographical papers of Professor Davis. As the editor says in his introductory note, they are reprinted without change, except that a few minor modifications have been made in style, and in a few cases, material modifications have been made to bring the matter into accord with recent discoveries. Of the twenty-six Essays which are here reprinted, the first twelve are educational, the remainder being physiographic in character. Three of the latter were originally published in this Magazine. H. G.

Descriptive Meteorology. By Willis L. Moore, LL. D., Sc. D. Pp. 344. 6 x 9. Illustrated. New York and London: D. Appleton & Co. 1910.

In his introduction, Professor Moore characterizes the *raison d'etre* for this book as follows:

"To provide, as far as possible, the young men entering the service of the U. S. Weather Bureau with a comprehensive introduction to modern meteorology. But to meet their needs in this particular is to provide equally well for all others who are beginning seriously this important science."

The work is divided into fifteen chapters, and a summary of its contents can perhaps best be given by an enumeration of their subjects, as follows:

The atmospheres of the earth and of the planets.
Atmospheric air.
Micro-organisms and dust motes of the air.
Physical condition of the sun, and its relation to the earth's atmosphere.
Heat, light, and temperature.
Thermometry.
Distribution of insolation and the resulting temperatures of the atmosphere, the land and the water.
The isothermal layer.
Atmospheric pressure and circulation, winds, clouds.
Precipitation.
Forecasting the weather.
Optical phenomena.
Climate.

The first four chapters deal to a large extent with matters only slightly related to meteorology, and might well be greatly condensed. To a less extent this is also true of the fifth chapter—that on heat, light, and temperature. The chapter on thermometry is devoted to a description of instruments and their installation. The next, on insolation, has a broad scope, including the distribution of temperature on land and water areas, its distribution in depth, both in the soil and water, its vertical distribution in the atmosphere, its distribution with latitude, etc.

The chapter on the isothermal layer sums up the results from a vast number of soundings of the upper atmosphere by means of balloons and kites. That on atmospheric pressure begins by describing the instruments used in its measurement. This is followed by an account of the general distribution of pressure over the earth, the general air movements, local movements, cyclonic movements, etc. This subject is concluded in the next chapter, that on winds, in which is included a description of the instruments used in measuring the direction and velocity of air currents. The chapter on clouds is brief, including their classification, formation, height, etc.

Precipitation is treated fully in all its forms, as to cause, distribution in time and space, modifying influences, etc., even to attempts to produce it artificially.

The application of much of what precedes is made in the next chapter, that on "Forecasting the Weather," being a description of the methods employed in this work in the Weather Bureau. Incidental to this are descriptions and explanations of many different phenomena of weather.

Optical phenomena include color of sky, coronas, rainbows, halos, mock suns, etc.

The final chapter defines climate as the average weather of a locality. It enumerates the meteorological data which constitute climate and the factors which modify and control them, such as latitude, altitude, topography, etc. Certain typical climates are described and their effects on the human race are characterized.

In the above attempt to summarize the contents of the book it must be understood that it is possible to hit only the high places, as the number of topics discussed is very great.

The matter is well arranged and the book is *readable*, a most excellent, though rare, quality in works on this subject. It is fully illustrated with maps and diagrams.

At the end of each chapter is a list of books treating on the subject-matter of that chapter.

Altogether this is a most comprehensive and excellent text-book on its subject. H. G.

Across the Sahara from Tripoli to Bornu. By Hanns Vischer, with foreward by Sir Harry Johnston. Pp. 304, 6½ x 9. 45 illustrations and map. New York: Longmans, Green & Co. Price, $3.50 *net.*

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THE NATIONAL GEOGRAPHIC MAGAZINE

THE DATE GARDENS OF THE JERID

BY THOMAS H. KEARNEY

With Photographs by the Author

WITH its feet in the water and its head in the fire," as the Arab proverb has it, the date palm is at home in the vast deserts that stretch from Morocco to the borders of India.

It thrives where the air is almost absolutely dry and where the summer temperatures are the highest on the globe. Under these conditions only do the best varieties of dates reach perfect ripeness. But as it is also necessary that the roots of the palm find plenty of moisture in the soil, the fruit is confined to the oases—favored spots in the deserts where never-failing springs or wells allow of irrigation.

No country is more celebrated for the excellence of its dates than the Beled el Jerid (Land of the Palms), a small group of oases situated at the northern edge of the Sahara and distant about 250 miles southwestward as the crow flies from the city of Tunis.

Some years ago I visited these oases in order to obtain palms for the date orchards which the National Department of Agriculture has established in Arizona and in the Colorado Desert of California.* My visit was so timed that I reached the oases soon after the beginning of the harvest. This made it possible to test the fruit of the different varieties while fresh from the trees and to select the best of them for introduction into the United States.

The Jerid is best reached by means of a railway which crosses southern Tunis from the busy little seaport of Sfax, on the east coast, to the rich phosphate mines of Metlaoui, near the Algerian frontier.

Leaving Sfax one morning in October, an all-day journey in a slow mixed train brought me to Gafsa, 25 miles from the end of the line. It was a desolate country through which we passed, wonderfully like the high plains of eastern Colorado and New Mexico.

An occasional cluster of "gourbis," or tents of skins, an occasional flock of multicolored sheep and goats, tended by half-wild Bedouin children, were the only signs of life in the monotonous landscape. The vegetation consisted

* In the southwestern United States there are deserts as hot as the Sahara. Rivers and artesian wells supply water for the irrigation of many thousands of acres. In the belief that the physical conditions meet all the requirements of the palm, the Department of Agriculture is devoting much energy to establishing date culture in this region. During the past ten years agricultural explorers have visited many parts of the great desert zone of the Old World in search of the best varieties.

MARKET PLACE AT TOZER

chiefly of brown clumps of the grass called "alfa" or "esparto," the long tough leaves of which are pulled by hand and shipped in bales to Europe for making baskets, straw hats, and paper of fine quality.

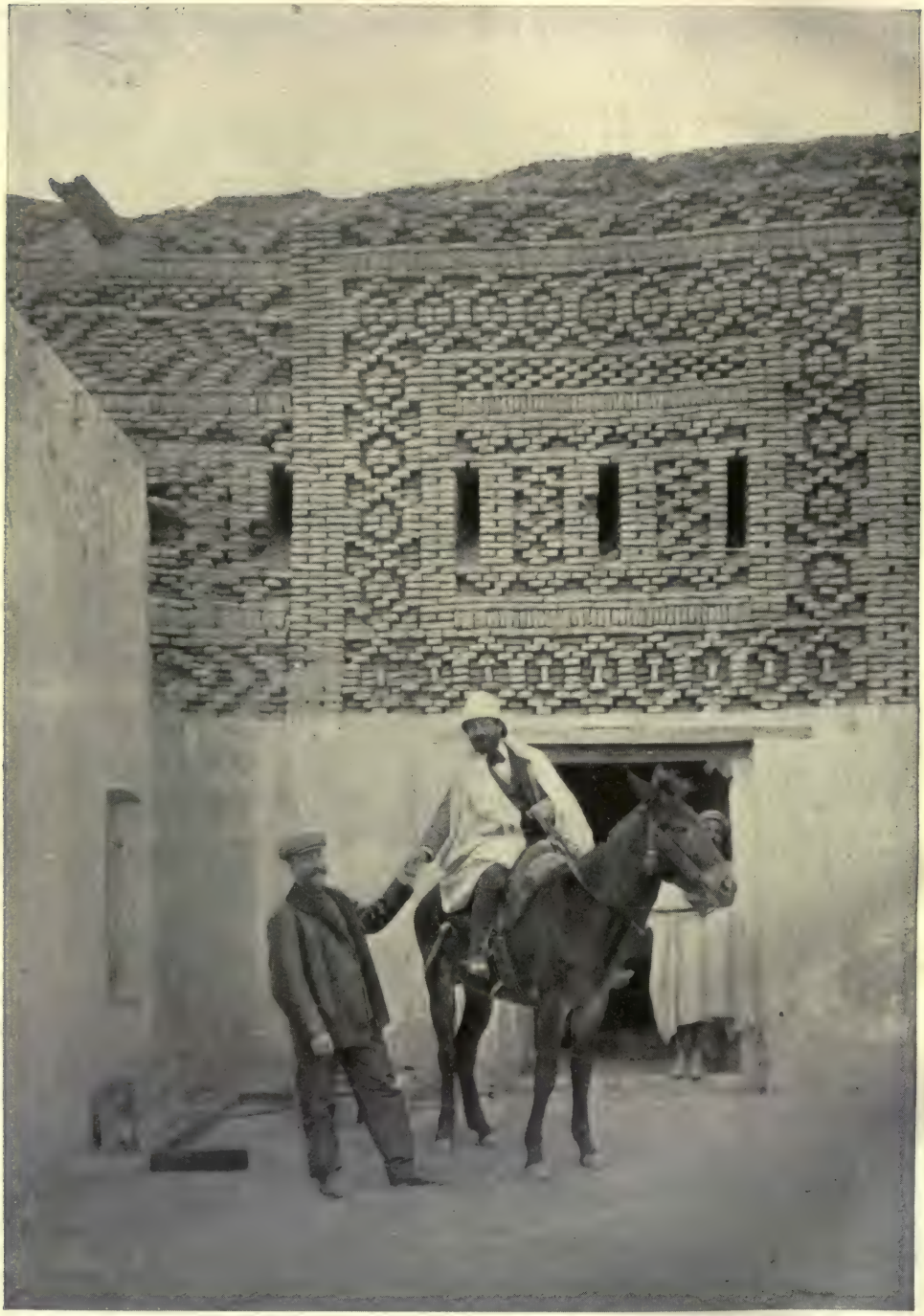
After spending the night at Gafsa, I was up betimes and took an early train to Metlaoui, the terminus of the railway. Here I was met by two Arab boys with donkeys sent by the Contrôleur Civil from Tozer, the chief town of the Jerid. A discharged soldier, returning to his oasis home at the expiration of his service in a regiment of "spahis"—the Franco-Tunisian cavalry—invited himself to join our company. It was a 35-mile ride over the desert from Metlaoui to Tozer.

Although late in October, the heat was intense. The road—a mere track and hardly distinguishable—followed part way the stony bed of a dry "oued," and then struck out across the desert. Overhead was the cloudless sky, underfoot the blazing sand, and around us the sharp forms of desert mountains, devoid of soil and trees. At midday we lunched in the scanty shade afforded by the mud brick walls of a little "bordj," a walled enclosure where travelers may encamp and, if need be, defend themselves against marauders.

The Arabs, who had hitherto beguiled the way with gutteral chatter and laughter and occasionally with a nasal chanting that kept time to the jog trot of the donkeys, were silent during the long, hot afternoon. Towards evening the air freshened and our tired animals quickened their steps. Alighting for a moment, Yusuf ben Mohamed, the ex-spahi, adjusted his fez with the aid of a pocket looking glass. Then, taking from his wallet a sash of crimson silk and giving one end of it to the donkey boy, he turned round and round until it was neatly wrapped in many folds about his waist. We were evidently nearing the end of our journey.

A few minutes later we paused on the brink of a deep ravine and saw before us—sharp and black against the red evening sky—a long fringed line of palm crowns. It was the oasis of El Hamma, the first of the Beled el Jerid. We skirted a corner of this oasis, passed through its

Dates grow in large bunches which contain hundreds of the fruit. Some of the clusters are so heavy that the fruit must be straddled on the nearest leaf stalk (as in this illustration) to prevent the stem of the cluster from being broken by the weight.



THE HOUSE AT TOZER IN WHICH THE AUTHOR ROOMED FOR SIX WEEKS

TOMB OF A MOHAMMEDAN SAINT AT THE EDGE OF TOZER OASIS

mud-brick village, and, after 9 miles more of donkey back, reached Tozer.

It was none too soon, for I was well nigh exhausted with the fatigue of bestriding all day the huge padded saddle on which the Arabs generally sit cross-legged. After a hasty dinner, I was installed in the one-storied house, built around three sides of an open courtyard, which was to be my home for the next six weeks.

In the morning the first duty was to present my credentials to the French administrator of the Jerid region. That functionary, who enjoys the double title of "Contrôleur Civil" and "Vice-Consul," received me courteously and detailed a spahi to accompany me in my explorations of the oases. Mounted on a fine gray horse and wearing a uniform consisting of a sky-blue burnous over a white "haik" or jacket, my guide made a picturesque figure. The one-eyed El Hachemi ben Achmid, who spoke passable French, was engaged as interpreter, and was thereafter a constant attendant during my stay in the Jerid. A scrawny boy who carried the camera completed the retinue, and without further loss of time we started for the gardens. Crossing the open market-place, on which face the modest public buildings, and winding through a series of narrow, crooked streets, we soon found ourselves on the outskirts of the town. Here, in a shallow stream, naked children were disporting themselves, and women, with skirts tucked up above their knees, were washing clothes. We then traversed a few rods of bare sand and plunged into the oasis.

The transition from the blinding glare outside to the cool shade of the gardens was delightful. Entering one of them, we found it a jungle of date palms, planted in no apparent order, some so close that the stems almost touch, and in other places far enough apart to leave room for little patches of vegetables and lucern and tender young barley. Beneath the tall palms there were other trees—figs, apricots, and olives.

Huge grape vines hung in festoons from the trunks, and long runners of melon and cucumber trailed over the ground. Here and there oranges and

THE TOWN OF NEFTA

The town is built on higher ground than the date gardens, which are unhealthy to live in (see page 554)

big rosy pomegranates gleamed in their setting of dark glossy foliage, and the jasmine, with its white corollas, starred the semi-twilight. Beds of scarlet peppers glowed like fires in the deep shadows among the trees.

The first garden we visited was the property of a wealthy sheik, who was waiting to receive us. The old gentleman's wrinkled brown face, picturesquely framed in the snowy folds of a huge turban, was all alight with cordiality as he led us, with many a greeting of "Salam" and "Sahha" (health), to a hut in the center of the grove. There were assembled his gardeners or "khammes." They were dark-skinned, sullen-looking men, clad in shirts and short baggy trousers of coarse blue cotton cloth, with arms and legs bare. A brief order from their master sent them scampering up the scaly palm trunks. In a few seconds they were with us again, the loose folds of their shirts bulging with dates of many kinds.

The harvest was already in progress, and it was interesting to watch the manner of gathering the fruit. Dates grow in large bunches, weighing from 10 to 40 pounds, which hang beneath the crown of leaves on long yellow or orange-colored stalks, hard and polished as ivory.

An expert workman, known as the "getaa," climbs to the top of the palm, gripping the scaly bark with his bare toes. He is armed with a "mengel," an iron knife, having a heavy serrated blade at right angles to the shank, which is set in a wooden handle.

Severing the stalk with a stroke of his knife, he gives the heavy cluster to the man who straddles the trunk just under him. It is then passed from hand to hand by men and boys who cling to the tree, one below the other, until it reaches the ground.

The number of the rungs in this human ladder depends, of course, upon the height of the palm. Sometimes seven or eight men beside the getaa are required.

Only the best varieties of dates are handled thus carefully; for the ordinary sorts it suffices to toss the cluster to the ground, where they are caught in sheets. They are then packed in skins or baskets to be kept for local consumption, or they are exchanged for wheat and barley, which the nomads of the high central plateaux of Tunis and Algeria bring down to the oases in the fall on the backs of their camels.

The fine Deglet Noor dates, of which the Jerid exports from one to two million pounds every year, are prepared for shipment before leaving the gardens. No curing is necessary. The divisions of the clusters are separated, the unripe and the spoiled fruit is culled, and the dates are packed on the branch in the wooden boxes in which they are despatched by parcels post to Europe. The finest are afterwards selected and arranged in the small oblong boxes, decorated with gaudy lithographs of palm trees and camels, that are seen in our fruit shops at Christmas time.

Riding back to Tozer at noonday for luncheon and siesta, we could make but slow progress because of the crowds that thronged the bridle paths among the gardens. Here and there where two roads crossed were stationed venders of broad beans. The beans, almost as large as chestnuts and not unlike them in flavor, were boiled in petroleum tins over charcoal fires and were sold hot to laborers and idlers.

The air was resonant with the shrill "ir-r-r-a" of the donkey boys and the shouts and songs of men and children. For the time of date harvest is a halcyon season in the Beled el Jerid. The long hot summer is over. The days are still comfortably warm and the nights just cool enough to be bracing. Dates are to be had for the asking, and all the world is well fed and contented.

In the afternoon we sallied forth for another visit to the gardens, returning through the cool twilight. Then for the first time I could appreciate the full beauty of the oasis. The level rays of the setting sun lit up the palm tops, turning the dull purples and maroons of the fruit clusters to glowing crimson and their stalks to burnished gold. Against

Photo by F. Soler

A GREAT ORCHARD OF DATE PALMS AT NEFTA (SEE PAGE 551)
Note the hollow in which the palms grow

the clear beryl green of the eastern sky the feathery leaf crowns were silhouetted. Overhead a star or two began to glisten in the azure that was fast changing to dusky violet.

Day after day of the delightful Saharan autumn was spent in these explorations, so that I soon became familiar with the topography of the region. The Jerid oases are four in number. Tozer and Nefta, which comprise about 6,000 acres each, are the largest. They are separated one from another by a few miles of sandy desert, where stunted gray bushes are the only vegetation during the greater part of the year. Immediately behind the oases rises a steep bluff, which here forms the northern boundary of the Sahara. The date gardens occupy a gently sloping shelf about one mile wide between this and the Shott el Jerid, a great shallow pond, usually covered with a glittering crust of salt and containing water for only a brief time after the infrequent winter rains. It is one of a chain of such dry lakes that stretches from near the eastern coast of Tunis to the Oued Rir country a few miles south of Biskra, in Algeria.

There are said to be nearly one million date trees in the Jerid. Each oasis is a dense forest, of which the ownership is much divided. The individual holdings range in size from a few square rods to several acres and are separated by "tabias," walls of dried mud surmounted by a palisade of the thorny palm leaves.

Numerous springs, gushing forth at the base of the escarpment that shelters the oases from the north winds, furnish an abundant and constant supply of water for irrigation. At Nefta the springs are situated in a deep basin, of which the sides are much higher than the tallest palm in the beautiful grove that covers its floor. This is the "Ras el Aïn" (Head of the Spring), which the French call the "Corbeille" or basket.

At Tozer and at Nefta the water of the springs is gathered into one large canal. It is then diverted by means of dams situated at convenient points into the irrigating ditches that penetrate every corner of the oasis. Long, shallow notches are cut in the palm log that forms the weir, and the number, length, and depth of these notches determines the amount of water received by the several divisions of the canal. Two guards are stationed day and night at each weir to regulate any dispute that may arise over water rights. To facilitate irrigation, the gardens are divided into little plots or basins, separated by low mud dikes.

More than one hundred distinct varieties of dates are grown in these four small oases. There is a bewildering amount of diversity in the shape, color, and flavor of the fruits. Some are round as apples, others egg-shaped, others finger-shaped. They range in size from that of a small hazel nut to the bigness of a man's thumb. When ripe they are of every imaginable hue, from golden brown to prune purple, and even jet black.

Very fanciful are the Arab names of many of the varieties: "bride's finger," "father of the cucumber," "ox brain," "pigeon egg," "gazelle's horn," are literal translations.

Some kinds are hard and dry, only moderately sweet, and have a nutlike flavor. These "dry dates," which can easily be kept for a year or more, are a staple article of food throughout northern Africa and southwestern Asia. They form a compact and nutritious ration, especially suitable for carrying on the long caravan journeys.

Other kinds, soft as butter and dripping with syrupy juice, must be eaten the moment they ripen. The excessively rich and sweet sorts are used only as a dessert.

The Deglet Noor—the name is sometimes translated "Date of the Light"—is the only variety exported in large quantity from Tunis to Europe and America. It is neither an extremely dry nor a very soft fruit, but has a firm, clean flesh, translucent as cloudy amber, and can be kept in good condition for several months after it is harvested. The inimitable

ENTERING ONE OF THE GARDENS WE FOUND IT A JUNGLE OF DATE PALMS

Photo from David Fairchild

AN IRRIGATING CANAL IN A DATE ORCHARD

flavor of this variety is the standard of excellence in dates.

No farmer's boy is more of a connoisseur in the qualities of the different kinds of apples in his father's orchard than are the Jeridis with respect to dates. Each of the best varieties has its partisans, and there is keen rivalry among the proprietors of gardens in extolling the merits of their favorite trees. The choicest fruits are picked one by one as they ripen in the clusters and are kept by the owner for his own table and for gifts to his friends.

One of the finest of all dates, rivaling the Deglet Noor in flavor and much larger, is the "Menakher," an extremely rare variety peculiar to the Jerid. When I sought to learn why a date which they esteem so highly should be so nearly extinct, the natives told a story that is a curious commentary on the state of Tunis before the French occupation. The Beys, it seems, were exceedingly fond of Menakher dates, and no other sort was served at their banquets. Each year, at the time of harvest, their agents visited the oases and took possession of the entire crop, usually without paying for it. The people wearied finally of this extortion and ceased to plant Menakher palms. They went even further, cutting down many of the old trees in their gardens.

The towns of the Jerid are situated on higher ground just outside the oases. They thus escape to some extent the malaria that lurks in the gardens, where frequent irrigation keeps the soil constantly moist. Even the gardeners dwell mostly in the villages and trudge every morning to the scene of their labors. Only during the ripening season, when the fruit of the choice varieties must be guarded against thieves, men camp among the trees in little palm-leaf tents, which are sometimes elevated on posts at a corner of the wall to afford a better lookout.

The houses are of sun-baked brick, similar to the Mexican adobe. In the façades of the more pretentious buildings the bricks are arranged in curious geometrical patterns, the only attempt at exterior ornamentation. The indispensable date palm furnishes whatever wood is needed in construction. The narrow streets are frequently arched over, making a deep shade that is very grateful at noonday. Benevolent householders sometimes place benches outside their doors in these arcades, where any passer-by is welcome to repose himself.

The population of the Jerid numbers about 30,000 souls, whose livelihood depends almost entirely upon the product of their palms. The Jeridis are sedentary, seldom venturing far from the shelter of the oases. They do not wander over the plains with flocks and herds as do the Bedouins farther north, nor are they conductors of caravans like their Algerian neighbors, the Soufis. They are a peaceable folk, and ever preferred paying tribute to making armed resistance in the days when the Touaregs and other warlike tribes of the Sahara were wont to raid the oases. They have lived for unnumbered centuries in the villages where we find them today, desiring no occupation but the care of their date gardens.

The beauty of their gardens was celebrated by the Arab geographers of the Middle Ages. In yet earlier times, when Tozer was the Roman Thusuros and Nefta was called Nepte, the oases existed, although possibly the olive rather than the date palm was then the principal tree.

Like nearly all successful agricultural populations of the Barbary States, the inhabitants of the Jerid are primarily of Berber stock, belonging to the race that peopled northern Africa before the coming of the Phœnicians and the Romans. But there is a large admixture of other racial elements, notably of the Arab and negro. The small tradesmen and handicraftsmen are mostly Jews. One even sees occasional individuals who have fair hair, blue eyes, and a light complexion, inherited perhaps from some Vandal conqueror or Christian slave of a later epoch.

A charming little denizen of the villages is the sparrow that nests in the

THE GARDENS ARE DIVIDED INTO SMALL PLATS BY MEANS OF LOW DIKES OF EARTH TO FACILITATE IRRIGATION

TURNING OVER THE RICH BLACK SOIL WITH THE MESSAH OR SHORT-HANDLED HOE, WHICH IN THE OASES DOES ALL THE DUTY OF A PLOW AND CULTIVATOR

(SEE PAGE 557)

chinks of the mud-brick walls. This is not our dingy city bird, but a glorified sparrow, who wears a dainty dress of russet and steel blue. Earliest dawn arouses him to cheerful twitterings and occasional snatches of sweet song. The Arabs call this bird the "Bou Habibi," the "Father of Friends," and believe that he brings good luck to any house in which he makes his nest. He is strictly a town dweller, never venturing into the desert and seldom met with in the gardens. Nothing in common has he with such nomads as the linnet and the skylark. He will not live in captivity, and attempts to naturalize him no farther away than the city of Tunis have always failed.

The Ramadan, the Lent of the Mohammedans, commenced ere I had been many weeks in the desert. From sunrise to sunset the natives took neither bite nor sup. By the middle of the afternoon the people of Tozer would be faint with hunger, and huddled in silent groups at the edge of the town, watching the sun as if conjuring it to hasten its setting. The moment it disappeared, the signal was given by a small cannon installed for the purpose in the market place.

Instantly all was noise and motion. Fires were lighted everywhere. The air was filled with the grateful odor of cooking. Lamps were hung out on the minarets and laughter and song resounded from every house. Most of the population devoted the entire night to revelry and were unfit for work in the daytime. The feast of the "Little Bairam" follows the month of fasting, and it was during those three days of childish merrymaking that I left the Jerid for a season.

Early in February I alighted once more from the "train mixte" at Metlaoui and rode southward across the desert. It was a brilliant day, the sky blue as turquoise, the air soft and warm. Crested desert larks, near relatives of the European skylark, rose at every few steps, scattering showers of low plaintive notes. This lark and the little black and white "Comforter of the Camels" were the only birds I saw in the open desert.

When I reached Tozer the gardens wore a changed aspect. The palms were bare of fruit. Here and there among their rough brown trunks gleamed the tender pink of blossoming apricots. The buds of the fig trees were beginning to disclose the lovely green of their young leaves. Hosts of linnets sang all day long in the palm tops, recalling the choirs of gold finches on May mornings at home. Gardeners, stooping low to their work with the "messah," the short-handled hoe, which in oasis agriculture does all the duty of plow and cultivator, were turning over the rich black soil.

The object of this second visit was to purchase and prepare for shipment the palms that had previously been selected for introduction into the United States. The date, be it said, like the apple and other fruit trees, does not "come true from seed." There is almost infinite diversity among the seedlings, with small chance that any will bear fruit exactly like that of the parent tree. It is only by taking up and planting the leafy shoots that spring from the base of a palm that the variety can be maintained unchanged.

The offshoots are fit to be removed and planted when they have begun to form roots of their own. The Jeridis say they are at their best for starting a new tree when their trunks are of the size of a camel's head. The oasis gardener, when about to take up one of these baby palms, first trims back its outer leaves, so that only two feet or so of the thorny stalks remain. He next digs a hole around and beneath it, severing its roots. With a heavy chisel he proceeds to divide it from the parent trunk. The roots are then cut off close to the stump and the offshoot is ready to be planted.

If it is to be transported to a distance, the base of the little palm is dipped in puddled clay to poultice its wounds. It is then snugly wrapped in several layers of "lif," a coarse brown-matted fiber that grows around the bases of the leaf stalks of the date. The wrapping of lif is secured by cords plaited from the same material. So wrapped, a healthy offshoot can be shipped without risk to the ends

A "SOFT" TYPE OF DATE (TRONJA), WHICH KEEPS FAIRLY WELL

Some are round as apples, others egg-shaped, others finger-shaped. They range in size from that of a small hazelnut to the bigness of a man's thumb (see page 551)

of the earth. It is by virtue of this simple method of packing that the Department of Agriculture has succeeded in introducing many of the choicest varieties of dates into Arizona and California.

Several weeks were spent in getting together the collection of palms, for the rarer sorts had to be sought far and wide. Of certain varieties but a single offshoot could be had in any one oasis. Only a few of the most popular kinds are found in some of the orchards, while others are veritable botanical gardens, containing a tree or two of almost every variety known in that part of the Sahara. Such is the celebrated garden at Nefta that once belonged to the sovereigns of Tunis.

A special quest was made for the Menakher, the royal date which was formerly reserved for the table of the Beys. But, after ransacking the Jerid, only nine plants could be obtained. One of these was a present from Si Brahim ben Mohamed el Ouadi ben Ouidi, a magnate of Nefta. After infinite coaxing, the great man came one morning, with the carefully wrapped offshoot in his arms, holding it as tenderly as though it were an infant in brown swaddling clothes. But even then the honor of presenting to the American Government a date palm of this rare variety had to be painted in the most glowing language my interpreter could command before Si Brahim was persuaded to part with his treasure.

The entire collection, some eight hundred offshoots, was at last ready for shipment. Four score camels were needed to convey the palms across the desert to the railway. With the drivers, many of whom were followed by their wives and children, it was a rather imposing caravan that assembled one morning at Tozer. Ten additional camels were to join the main body when it should reach El Hamma. Meanwhile a cold north wind sprang up, filling the air with dust and sand. Late in the evening came word that the El Hamma contingent refused to set forth in the face of the storm. This was unwelcome news, for

An expert workman, known as the "getaa," armed with a "mengel," an iron knife having a heavy serrated blade, with which he cuts off the bunch of ripe dates (see page 549)

The ordinary sorts of dates are exchanged for wheat and barley which the nomads of the high central plateaus bring down to the oases in the fall (see page 549)

PACKING THE DATES FOR SHIPMENT: ALL THE BEST DATES ARE EXPORTED

THE TALL MINARET OF THE MOSQUE IN AN OASIS TOWN

arrangements had been made to ship the palms by a steamer that was due to sail from Sfax within a few days. In this emergency I consulted the Caid of Tozer, the principal native official of the Jerid. He took prompt and decisive action, at once despatching a spahi with imperative orders to the refractory camel drivers to proceed without delay.

When I reached El Hamma early the following morning, I learned that this emissary had tried first persuasion, then threats, and at length had resorted to blows. A sound drubbing convinced the recalcitrants that the weather was not sufficiently inclement to prevent traveling, and at midnight they departed. I soon overtook them and found them

By the middle of the afternoon the people would be faint with hunger and huddled in silent groups at the edge of the town, watching the sun (see page 557)

SCENE IN AN OASIS TOWN Photo from Bishop J. C. Hartzell

Photo from Bishop J. C. Hartzell

CHILDREN OF THE DATE GARDENS

CAMEL WITH LOAD OF DATE OFFSHOOTS PRESENTED BY THE PEOPLE OF THE OASES TO THE UNITED STATES GOVERNMENT

It required 90 camels to carry all the offshoots across the desert to the railway

marching along dejectedly, for not only were their shoulders still aching from the beating of the night before, but they would have to pay a fine of one franc for each kilometer traveled by the spahi who administered the punishment. Such, El Hachemi assured me, was the law of the country.

At noon I came up with the main caravan, which was traveling in very open order. The camels were walking side by side and browsing as they went, while the drivers plodded afoot through the sand. The sheik or leader was a tall, well-set-up Soudanese, with skin as black as ebony. But most of the drivers were natives of the Souf oases, who have almost a monopoly of this vocation in the Algerian and Tunisian Sahara. Their sturdy limbs and dark, smiling faces offer a striking contrast to the lank forms and sullen, anæmic visages of the stay-at-home residents of the Jerid.

When the sun dipped below the horizon that afternoon the last camel had been unloaded at Metlaoui, and the palms were stowed away in the freight cars that waited to carry them to the coast. The drivers from El Hamma, who had made remarkable speed at the last, went away rejoicing when they learned that their fine would be remitted. A few days afterward I had the pleasure of watching the good ship Tafna as she steamed out of the harbor of Sfax with the cargo of date offshoots snugly reposing under tarpaulins on her deck.

Ten weeks passed by, and the little trees reached their journey's end in the new oases of the American Sahara. They were soon safe in the ground, alongside their cousins from the banks of the Nile and from Muscat and far-away Bagdad.

With the blazing sky of the desert once more above them and the life-giving water about their feet, they are growing and ripening their fruits as if there were no 8,000 miles of land and sea between them and the mother palms of the Jerid.

GATHERING THE DATE HARVEST Photo by F. Soler

The top man hands the heavy cluster to his fellow just beneath, by whom it is passed from hand to hand until it reaches the ground. Note the oranges growing under the palms

CARRYING WATER THROUGH A DESERT

The Story of the Los Angeles Aqueduct

By Burt A. Heinly

GOD sowed the Mojave from an almost empty hand, they say, and so perhaps He did. For a few weeks of early spring this desert blooms as a paradise, but the blossoms bring no fruits. Quickly the broad acreage of flowers relapses into the sullenness of mile on mile of yellow sand, scorched day after day from the heat of a glaring sun. The rattlesnake finds protection in the narrow shade of the sage brush. With the exception of the lizard, other creeping things seek their holes and come forth after dark. Death Valley lies within Mojave's depths, while the western confines are bounded by the Sierra, into whose canyons run windrows of sand like fingers groping in the dark.

It is almost paradoxical that one of the most Titanic struggles ever undertaken by a municipality is being carried on within this desert waste, and the struggle is one for water.

At the northern outpost of the Mojave's sands a river, after gathering the drainage of the snow-clad Sierra for more than 150 miles, flows into an alkaline sink and wastes its fatness in evaporation from the sun's heat. One hundred and fifty miles across the Mojave, straight southward as the crow flies, rises the mountain wall of the Coast Range. Beyond lie foothills undulating into valleys, and a broad coastal plain on which nestle nearly 100 communities about the central metropolis of Los Angeles.

It is the plan of Los Angeles to carry the waters of this river and its tributary streams 250 miles southward across the Mojave Desert, beneath the Coast Range, and into the San Fernando Valley, where the precious fluid will be used to quench a city's thirst, to irrigate thousands of acres of rich soil now non-productive for want of moisture, to develop electrical energy to light her buildings and her streets, and furnish power for manufacturing industry on a scale new to the Pacific Coast.

The enterprise is now in the third year of its accomplishment, and will require from two and one-half to three more years for its completion. Five thousand men working through the blinding heat of the summer day and the blessed coolness of the desert night could tell the story better than pen can write.

THE CITY DOES ALL THE WORK WITH ITS OWN WORKMEN

Mr John R. Freeman, the eminent hydraulic engineer, who is known for his connection with the Panama Canal and the New York Aqueduct, in describing the features of the project to a body of Boston engineers recently, classed the Los Angeles Aqueduct as the most interesting hydraulic construction now under way on the American continent. It is not the largest. The Panama Canal, the New York Aqueduct, and the Erie Barge Canal all outrival it in the order named, but in not one of these are to be found the features which make this project so spectacular in construction and so full of promise after completion.

The enterprise is not alone interesting because of the magnitude and the seemingly insurmountable difficulties being overcome, but it is remarkable because it is a public work which has been built at much greater speed than was promised and with less money than it was stated would be required. The city is doing the building with its own workmen and with its own engineers, one small contract excepted.

Only in the arid West does one come to a full realization of the value of a drop of water. Here it becomes the pearl without price. In a land where the rains fall with the first days of November

TWO CATERPILLAR TRACTION ENGINES COUPLED TOGETHER AND HAULING ONE OF THE BIG POWER-SHOVELS INTO THE DESERT, WHERE IT IS TO BE PLACED AT TRENCH EXCAVATION

A STEAM SHOVEL AT WORK DIGGING THE CONDUIT THROUGH THE DESERT

and cease with the coming of April, not to descend again until the approach of another winter, the truth of this saying is appreciated. Los Angeles lies in the heart of such a land, where through the long summer growing things usually mark moisture artificially applied.

Five years ago, when the city stood face to face with the grave problem of a steadily decreasing water supply and a rapidly increasing population, Owens Valley, the cleft in the Sierra from which the waters are to be taken, was almost unknown. Today even the children of the public schools have familiarized the location and characteristics.

The valley is a narrow one. Seven miles will span it at almost any point. To the eastward are the brown Inyos, to the westward the white Sierra. This latter range of mountains forms the roof-shed of the United States. Mount Whitney, snow-clad monarch of them all, rises to a height of 14,502 feet. Twenty-three other peaks exceed 13,500 feet in elevation. Along the Sierra the snows lie deep throughout the year. From the base 35 streams debouch and pour into Owens River from a drainage of 2,800 square miles.

Since the time when the land was new this river has spent its volume in alkaline Owens Lake, which has an approximate area of 75 square miles. Without an outlet, the very high evaporation of 90 inches each year has kept the lake at about the present size. Some water from the river has been used for irrigation in the valley, but by far the larger part has done service for no man.

To insure a water free from alkali, Los Angeles has gone 35 miles above the mouth of the river to build the intake of the aqueduct, and the supply that the city will use in the future will be of almost half the mineral content that its citizens are now drinking. There are a few scattering settlements in the valley, but the rugged mountain chain which yearly sends down its floods offers scant encouragement to the settler. Moreover, the government has included the territory within a forest reserve, so that freedom from human contamination, apparently, is forever preserved.

SECURING THE LAND RIGHTS

The ranches which carried water rights were purchased for cash in hand. Land was cheap then in Owens Valley. Los Angeles bought 120 square miles for a little over $1,000,000, and did this so quietly by the use of water-works funds that speculators who follow a city in its enterprises like dust follows in the rear of an army were unaware of their opportunity until too late. Compare the expenditure for this item with the millions which New York city has paid to insure the pureness of its new supply.

So much for the prize for which Los Angeles paid little more than a million, and for which it is now expending $23,000,000 to bring within the city limits! Now to follow the sinuous course of aqueduct building, marked today by hundreds of tents and unpainted buildings strung out along the desert, or perched high on mountain sides, or hidden away in canyons.

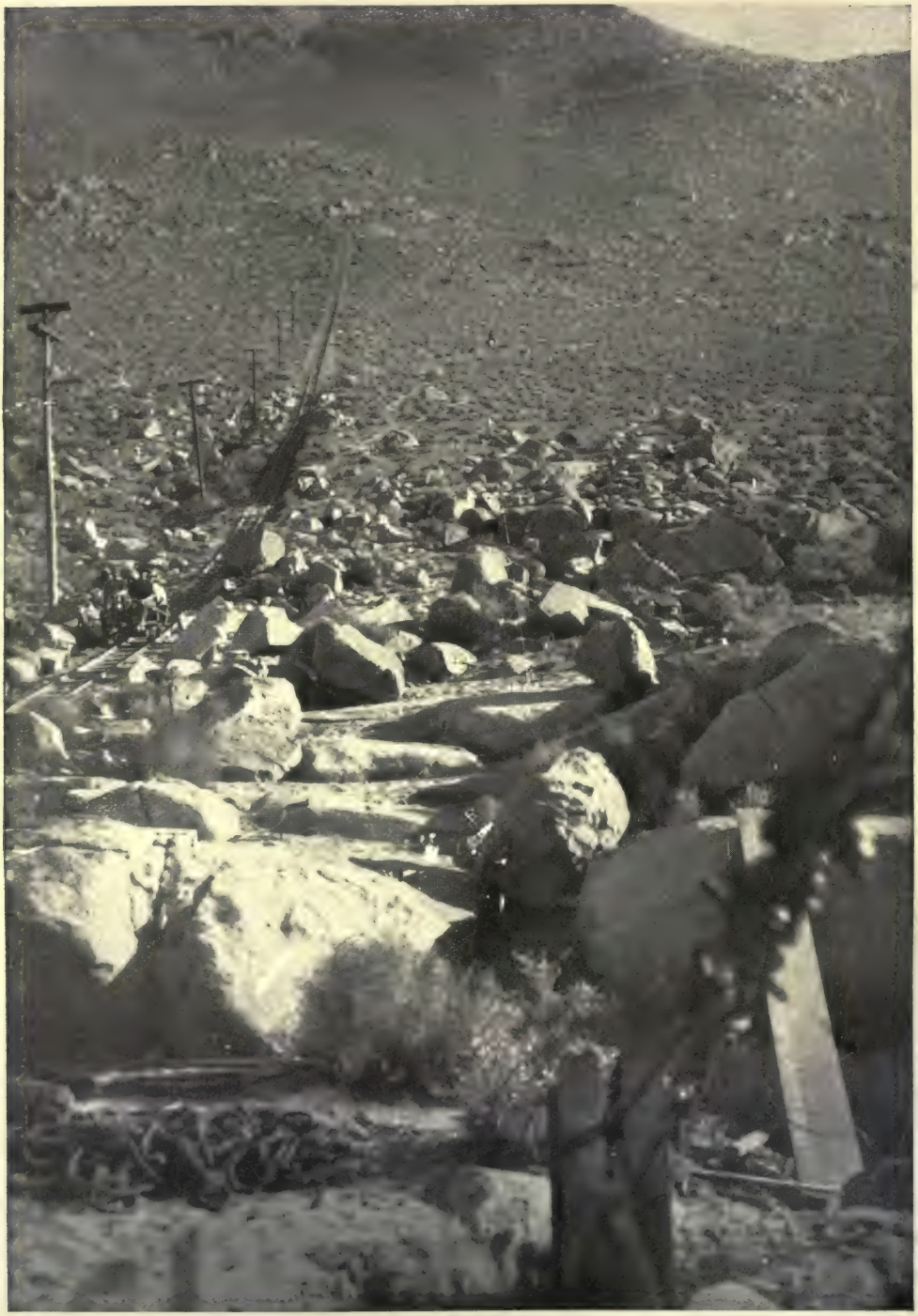
The big water-course is designed to deliver a daily supply of 260,000,000 gallons to the two storage reservoirs at its lower end.

The first 22 miles, from the intake to the toe of the Alabama foothills, is in canal 50 feet wide and 10 feet deep, uncemented and at a slightly higher elevation than the river. The excavation is here being done by three electric dredges working night and day, and with 8 miles completed April 1, 1910.

At the Alabama foothills we strike into the mountain side, where a concrete ditch 18 feet wide and 15 feet deep is being constructed. This will receive the flow of half a dozen good-sized mountain streams in addition to that of the river, and will carry the water, at an elevation of 200 feet above the surface of Owens Lake, a distance of 38 miles to the Haiwee reservoir.

THE STORE-HOUSE OF THE WATERS

The Haiwee basin is the old course of the Owens River before the stream was



WHERE ROADS ARE NOT PRACTICAL, LOG RAILWAYS AND AERIAL TRAMS CARRY MEN AND MATERIALS TO THE POINT WHERE THE ENGINEERS HAVE LAID OUT THE COURSE OF THE AQUEDUCT

ONE OF THE MANY SMALL AQUEDUCT SUPPLY STATIONS IN THE HEART OF THE MOJAVE DESERT

J. B. Lippincott, Assistant Chief Engineer (with book); Hon. Fred Eaton (center), father of the Owens River project; William Mulholland (side), Chief Engineer

dammed into Owens Lake, and at a time when Mother Nature was making over the Western Hemisphere. When the hydraulic-filled dam is completed, the reservoir will have an area of 15 square miles, and will serve for storage, regulation, and clarification of the summer floods. Once full, if its supply were to be cut off entirely the storage capacity is sufficient for the needs of Los Angeles for more than three years.

From the Haiwee reservoir the water will be carried southward in a closed concrete conduit for a distance of 125 miles, following, as a rule, the contour of the country through which it passes. Sometimes the snaky thing of dirty white will lie along the surface of the desert; at other times it will rest in niches cut in rocky mountain walls; canyons it will descend on one side, then ascend the other as a large cylindrical metal shell nearly an inch in thickness; mountains which forbid ascent will be burrowed. When at length the northern base of the Coast Range has been reached the waters will be given rest in the Fairmont reservoir, but only temporarily.

HOW THE WATER WILL BE RELAYED

From the bottom of the basin, which is one for regulation, the water will pass 26,860 feet through a tunnel under the Coast Range to come out on the edge of San Francisquito canyon; thence for 11 miles through conduit and tunnel to be shot down 800 feet upon the restless wheels of two large hydro-electric plants; thence for 7 miles and another sheer descent of 700 feet to develop more electric power; then on again 16 miles to a third power plant, finally to find freedom in the San Fernando reservoirs.

These two basins perched on the rim of the San Fernando Valley will look down 1,000 feet upon Los Angeles, 20 miles away, and a score of other towns and cities of the Pacific coastal plain. No pumping is anywhere necessary. The only expense will be that of maintenance, which should be small because of the enduring character of the materials em-

BUILDING THE GRAY RIDGE ROAD IN THE JAWBONE DIVISION

Eight miles were cut out of solid rock. The background gives an idea of the boldness and barrenness of the mountains in the Jawbone Division of the aqueduct

ployed in the construction. From the intake, at an elevation of 3,800 feet, the water of its own gravity will flow with gentle velocity, excepting at points where power is developed, to the impounding basins at the lower end, and will there be drawn off as needed for irrigation and domestic use.

The size and the shape of the conduit south from the Haiwee reservoir vary greatly. Both are determined by the character of the country and the soil formation. The average size of the excavation now being made is 12 feet wide and 10 feet deep.

With the exception of the 22 miles of unlined canal and the 38 miles of lined conduit which empties into the Haiwee reservoir, the aqueduct is being covered. The lining of concrete for the conduit ranges from 8 to 12 inches. The concrete slabs moulded into a covering have a thickness of 6 inches and are reinforced with steel.

There are 22 miles of canal, 43 miles of tunnels, 15 miles of steel siphons and concrete flumes, and 137 miles of concrete-covered conduit, with 13 miles of the remaining distance made up by reservoir distance. This makes a total of 230 miles from the point of intake to the lower outlet. Thence the water required for domestic consumption will be carried 20 miles in a riveted steel supply main, which will empty into the reservoirs of the city's present distribution system.

This is the Los Angeles Aqueduct. The major portion of the most difficult and expensive part of the work is finished. In point of difficulty 68 per cent of the aqueduct and 46 per cent in distance is completed.

THE GROUNDWORK OF THE PROJECT

Let us go back five years and with the first party of engineers examine the bare expanse across which they were expected to search out the cheapest and most feasible route. There was then a rambling trail that led out of Mojave on the Southern Pacific north to Keeler on the shores of Owens Lake and the terminal of the Carson and Colorado narrow gauge. The path was dug into the desert more than 40 years ago by the wheels of "Remi" Nadeau's 20-mule freighters, which carried the rich silver ore of the Sierra Gordo mine to the port of San Pedro at the rate of four cents a pound. Wind and sand and cloudburst in the mountains have changed it somewhat with the years, but Vasquez and his gentlemen of the road, were they alive today, could still pick out the points of vantage where they gave unwelcome greeting to travelers of the trail.

For four decades and until 1909 a stage coach, vestige of the days of '49, made tri-weekly journeys as the only method of communication and transportation between Mojave and Keeler, stopping at seven points for change of horses. These seven points mark as many waterholes. You will not find the precious fluid elsewhere along the path. Had you not the wherewithal to ride, and had the trace of wheels been blotted out, you could have still guided your steps by empty bottles. It is a dry land and brings thirst quickly.

At times even fuel with which to cook—and fuel was sage brush—became a rarity for these engineers. One party followed another until there were more than 200 men in the field. With laborious effort they marked their progress with a line of stakes set 50 feet apart, sometimes in places where a human foot had never trod nor cared to tread. They found little or no water, no fuel for the development of power, no railroads to carry materials, men, and subsistence, and for 100 miles within the zone of the aqueduct not even trails.

The $23,000,000 bond issue was voted June 13, 1907. Immediately the portion of the plans of these engineers that called not for aqueduct excavation, but for overcoming obstacles by which aqueduct construction might be accomplished, began to materialize.

A FEW OF THE DIFFICULTIES OVERCOME

They built 225 miles of road and trail, one notable example in the Jawbone Division being hewn for 8 miles in solid

IN THE SOUTH PORTAL OF THE ELIZABETH TUNNEL, WHICH IS NEARLY FIVE MILES LONG (26,860 FEET), AND PASSES UNDER THE COAST RANGE

THE MUNICIPAL CEMENT MILL, WITH CLAY BEDS AND LIMESTONE QUARRIES, COSTING $750,000

rock at a total cost of more than $40,000. They laid 180 miles of water mains from springs far back in the mountains to the line of the aqueduct. These systems are four in number, and with reservoirs at high elevations insure a copious supply of pure water for domestic use and for the mixing of concrete. They staked the course of a standard gauge steam railroad 125 miles in length with the expectation that the city would construct, own, and operate the line. The Southern Pacific stepped in, however, and in return for the handling of the 1,000,000 tons of aqueduct freight took the transportation problem off the city's hands. The new road is completed today from Mojave to Owens Lake, and by fall will be in operation to the mouth of the Owens Valley. The railroad parallels the aqueduct as far as this is feasible.

Materials and supplies are stored in warehouses along the tracks and thence are trucked by mule-team freighters or caterpillar traction engines to the places where they are required. For long stretches the aqueduct lies at an elevation of 1,200 feet above the desert, and at points where road construction is not feasible aerial cables serve as carriers.

With the questions of water supply and transportation out of the way, there yet remained the problems of communication and of power for the mechanical equipment. The difficulty in the first instance was disposed of by the building of a copper wire telephone system from the headquarters in Los Angeles to the intake, 250 miles north. From the main line branches ramify into each of the 100 or more camps, so that the chief is always in touch with his engineers.

The energy of two mountain streams have been utilized to furnish power. Three hydro-electric power plants generating a total of 3,300 horse-power have been erected, and the electric fluid is carried over high-resistance transmission wires as far southward as Mojave. By this means the three dredges are driven, many of the power shovels, all the tunnel equipment, half a dozen machine shops, and a cement mill, not to mention the lighting of all the camps. The expense has amounted to one cent per horse-power per hour. To have employed steam at the high cost of fuel, not to consider the scarcity of water, would have cost ten times this amount.

The sandy waste that for centuries has felt only the light tread of the skulking coyote today crunches under the wheels of heavily laden lumber freighters, and canyons that had heard only the wailing cry of the mountain lion resound with the tattoo of hundreds of hammers. The sometime path of the aqueduct through the silent desert became a scene of transformation. Barns, warehouses, laborers' quarters, mess-halls, power-houses, and hospitals went up as if by magic. Where there was immediate need, white tents arose over night like mushrooms in a pasture after an April rain. Eight months saw 500 wooden structures erected and 600 temporary canvas shelters.

THE CITY MANUFACTURING ITS OWN MATERIAL

In the estimate of materials required, 1,200,000 barrels of cement was the principal item. Cement is a mixture of limestone and certain clays rightfully proportioned, burned, and ground to an impalpable powder. Mixed with sand and gravel and water, it forms a concrete that, after being allowed to set, has the hardness of rock.

Almost midway between the intake and the outlet of the big watercourse, and on the main line of the Southern Pacific Railroad, the city's engineers discovered excellent deposits for the manufacture of cement.

No city previous to this time had entered into the cement-making business, but Los Angeles, undeterred, purchased the lands and began the erection of a plant. Los Angeles today owns the village of Monolith, is the sole employer of the 250 laborers and skilled artisans dwelling therein with their families, and every 24 hours ships out along the aqueduct more than 1,000 barrels of cement. Even at this rate the mill cannot keep pace with the unprecedented speed of

PLACING THE FORMS, TO BE FOLLOWED BY THE POURING OF CONCRETE

BUILDING THE AQUEDUCT IN A NICHE CUT HIGH ALONG THE MOUNTAIN'S FACE
The steep pitch of the land is shown in upper half of photo

building, and recourse is also had to corporation mills.

In two localities within the aqueduct zone deposits of tufa or volcanic ash have been discovered, and grinding plants have been erected at both points. The product is mixed with the Monolith cement to form a mixture stronger but closely similar to the material used by the Romans in the construction of their aqueducts 2,000 years ago, and which are doing service to this day.

While this preliminary construction was in progress 18 months rolled around. In December, 1908, the Los Angeles Chamber of Commerce called upon the chief engineer to give a statement of how much of the aqueduct had been completed to that date.

Mr Mulholland met the committee of this body with some trepidation. It is human nature, whether in Maine or California, for taxpayers to demand results, and these immediately. "Well," he answered, "we have spent about $3,000,000 all told, I guess, and there is perhaps 900 feet of aqueduct built. Figuring all our expenditures, it has cost us about $3,300 per foot"—this defiantly. He waited for his words to sink in; then added, "But by this time next year I'll have 50 miles completed, and at a cost of under $30 per foot, if you'll let me alone."

"All right, Bill," said the chairman. (In Los Angeles, grown from a village to a metropolis in a decade, the residents still call each other by their first names.) "Go ahead; we're not mad about it."

THE RESULT OF CO-OPERATION AND CONFIDENCE

Herein is to be attributed no small part of the success of the undertaking. Mulholland has the confidence of the community. It believes in him implicitly, and he believes implicitly in the job and the men under him. "If Mulholland told these people he was building the aqueduct out of green cheese," said a newspaper reporter, "they'd not only believe but take oath that it was so."

The project is inseparably associated with the man and his life's work. He is now 54 years of age and is Irish by birth. At 20 he came to America. Two years later he landed in California with a fair education, a wonderfully retentive memory, ambition to improve himself, and $10 in his pocket as his capital. His first work was in digging artesian wells. Six months afterward he accepted a position as "zanjero," or ditch-cleaner, for the Los Angeles City Water Company. For three years he lived alone in a cabin far up in the Los Angeles River bottom. His days were passed in ditch-cleaning, his nights between sleep and study. Step by step he pulled himself upward. In 1882 he was made superintendent and chief engineer of the company. The impecunious policy of the corporation and an inability to keep pace with the growth of the city forced the municipality, in 1902, to take over the property.

Mr Mulholland was retained in his position, and a non-political Board of Water Commissioners was placed in office. Under the supervision of Mr Mulholland and these men the enterprise prospered exceedingly. Today it is one of the three most successful water works in the United States.

No sooner was the water department upon a firm basis than Mr Mulholland set about to seek a source of supply larger than that of the Los Angeles River. Mr Fred Eaton, at one time superintendent of the City Water Company and later city engineer, then mayor of Los Angeles, had lived in the Owens Valley for 13 years. He felt confident that in this cleft in the Sierra lay the city's only hope. Mr Eaton prevailed upon Mr Mulholland to visit the valley with him, and he returned with the conviction that Mr Eaton had found what he himself had sought without avail. Neither the great distance nor the seemingly insurmountable obstacles could frighten him. He knew only that Los Angeles must have water to continue her existence as a city, and that the water must come from the Owens Valley, 250 miles in a straight line to the northward.

The Water Board purchased or took options on $1,000,000 worth of land and water rights solely upon his recommendation, the money being advanced from

PUTTING ON THE COVER OF THE AQUEDUCT IN THE MOJAVE DESERT

SHOWING OPEN CONDUIT AND THE COVER IN PLACE

the revenues of the water department, of which the board has the right of expenditure.

FINANCING THE PROPOSITION

In 1905 the people voted $1,500,000 in bonds to pay for these properties and carry on the preliminary engineering investigations. When his plans and estimates had been approved by a board of consulting engineers of national reputation, they voted $23,000,000 more to complete the project. This was the extent to which the people could bond themselves under their charter from the State, and was a tax of $88 upon every man, woman, and child within the corporate limits. They knew also that they would be called upon to vote upwards of $6,500,000 more bonds for the electric-power development as soon as the city, by its growth in taxable property, could legally do so.

Here, certainly, was not only an enduring faith in themselves, but a blind trustfulness in the man who had told them what they must have and how they could get it.

The faith was built largely upon the successful operation of the present water system, the known honesty of the public servants identified with the plant, and the absolute freedom from all politics which has been maintained in the water department since the city began the purveying of its water.

The confidence that has been given Mr Mulholland and his chief assistant, Mr J. B. Lippincott, formerly United States Government Reclamation Engineer for the Pacific Coast, they have passed on to the men whom they have assembled about them in the work.

By the time the preliminary preparations for construction had been completed an efficient organization had been developed. The line of the aqueduct was apportioned into 11 divisions, the length ranging from 6 to 23 miles, depending upon the character of the construction. An assistant engineer was placed in charge of each of these and given large latitude in the management of its affairs.

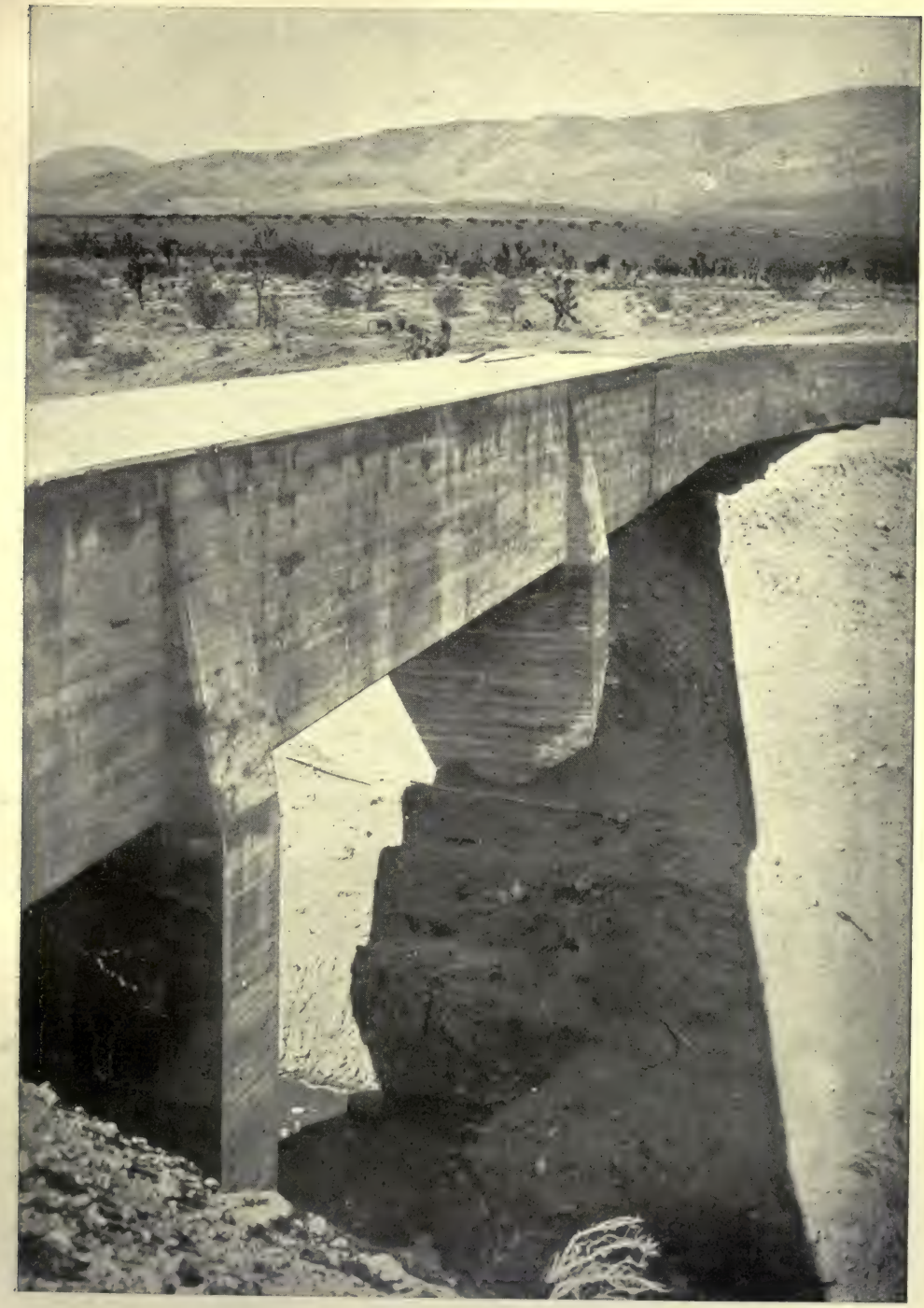
THE QUESTION OF THE CONTRACTS

When the time came to determine whether the work should be done by contractors or under the direct supervision of the city, the aqueduct engineering force stood ready for the latter upon 30 days' notice. Mr Mulholland was anxious that the city should do its own work. He contended that this was what he and his assistants had been employed to do, but the Board of Public Works, which has the expenditure of bond moneys, was undecided.

Bids for the construction of the Jawbone Division, comprising 23 miles of the most difficult excavation, were advertised. The proposals ranged from 50 to 100 per cent higher than the estimates which had been prepared by the city's engineers. The board told Mr Mulholland to roll up his sleeves and pitch in. Three weeks after the command was given they were opening the first tunnel portals. This was in November, 1908. Just 12 months later a little over 50 miles of conduit, tunnel, and canal had been dug. In the Jawbone Division the cost was in many instances 50 per cent less than the figure demanded by contractors, and the entire 50 miles required an expenditure of between 10 and 12 per cent less than city engineers had estimated.

At the time the bonds were voted the promise was made that the enterprise would be finished in the summer of 1913. April 1 the Aqueduct Bureau, basing its estimates upon the work already accomplished and the daily rate of progress, stated emphatically that Owens River water would be delivered in Los Angeles by May 1, 1912, and at a cost less than the $23,000,000 which the people had provided. How much less they did not pretend to say, but there were intimations that it would be a round $2,000,000. However, June 1 the flurry in the money market caused the city's New York bankers temporarily to stop taking aqueduct bonds until some time in the fall. Construction was therefore immediately scaled to meet the new conditions, as the bureau at the time had little more than $800,000 on hand. A popular subscrip-

ONE OF THE AQUEDUCT TUNNELS



THE AQUEDUCT SPANS SMALL DESERT WASHES BY RECTANGULAR CONCRETE CULVERTS

tion for aqueduct bonds will be opened during July for the purpose of adding to this fund.

The loss of time, and, what is of greater hurt, the partial destruction of an organization wonderful in its efficiency, will extend the time of completion somewhat beyond May, 1912. Despite the temporary delay, due entirely to the unforeseen financial conditions, there is every reason to believe that the task will be accomplished well within the original time limit.

Six months after the opening of the Jawbone Division, the Board of Public Works let a small contract of 10 miles of easy conduit and tunnel section, because the board desired to be able to compare private and municipal efficiency, the result to guide them in the building of the remaining aqueduct mileage. The city, with the exception of this one contract, is doing all its own work.

Basing the cost upon contractors' bids for the completion of the Jawbone Division and the extras made necessary on the single contract, the aqueduct could not have been completed under $40,000,000. This statement is based upon the careful figures of the aqueduct's cost-keeping department.

Throughout the country there are an overwhelming number of illustrations to show that where a municipality undertakes its own public work, the cost and period of construction range from one to one and a half times more than under private contract.

THE CITY DIVIDES THE PROFITS WITH THE WORKMEN

What, then, are the reasons for the unexampled speed and low costs? First, undoubtedly, is the complete preparedness provided before any excavation was attempted. Secondly, the efficiency of the men and the organization of which they are a part. This is a public work without any politics. All employees are American. There is no contract labor employed. There are no men on the pay-rolls who have outlived their usefulness, or have been failures in life and have found a berth because of friendship at the city hall. Youth and virility fill the ranks of the 5,000. Every man in a position above that of day laborer received his certification from the City Civil Service Commission. He holds his place provided he is competent for the duties assigned him and not othewise. He climbs upward and is given preference as he shows himself capable.

Every one works for records. These are published for each 10-day period and sent broadcast by the cost-keeping bureau, and thus the spirit of rivalry is fostered and intensified. When a camp once gains the pennant for good and rapid work it strives with all its might to retain the emblem.

The city further divides with the men the profits which result to the municipality from unusual endeavor on the part of its employees. A careful determination is made of how much tunnel can be bored in a certain character of rock or soil by a crew in 10 days, or the average distance that should be made by a power shovel or a concrete gang in the same interval. Wherever the set distance is exceeded, every 10 days the city pays a bonus to each man for every extra foot accomplished. Under this system the workmen themselves drive out the laggards and the drones. Drones and laggards retard progress and cut down the bonus. That the city's policy is a paying one is shown by the fact that all American records for tunnel boring have been repeatedly broken, as well as those for other forms of excavation and cement working.

The engineers have not participated in the money awards. When the opening of the aqueduct was placed one year ahead of time, an assistant engineer complained to the board: "This is a great thing for the under dog, but where does the engineer come in? His only reward is to work himself out of a job as quickly as possible, while the men under him reap the benefit in increased wages."

"We hadn't thought of that," admitted General Chaffee, who is at the head of the Aqueduct Advisory Board. "We'll look into it." Two weeks later a notice was posted of a substantial increase in

BUILDING AN INVERTED SIPHON ACROSS WHITNEY CANYON TO CARRY THE WATER DOWN ONE SIDE AND UP THE OTHER (SEE PAGE 574)

ANOTHER VIEW OF AN INVERTED SIPHON: IT IS BUILT OF CONCRETE HEAVILY REINFORCED WITH STEEL (SEE PAGE 576)

UNDERCUTTING FACE OF BANK: THE DREDGE IS DRIVEN BY ELECTRICITY

salaries for assistant engineers and superintendents. A day laborer who has a complaint receives the same courteous treatment and there is the same willingness on the part of the board to investigate.

June 1, 1910, 99.9 miles of aqueduct had been excavated. Of this, 36 miles was tunnel, bored for the most part through solid rock at the average rate of almost two miles per month. Think of it! For the last ten days of May the total distance in tunnel, conduit, and canal excavated was 16,983 feet, or at the rate of very close to *ten miles per month.*

THE SUPPLY AND THE DEMAND

Necessity is a relentless taskmaster, and it was dire need which drove Los Angeles to its conquest of the desert. However, from a commercial viewpoint, the financial returns from this source are small indeed compared with the revenues which must accrue from the sales of water for irrigation and from the disposal of electric energy.

The city paid $2,500,000 in round numbers for its present supply and distribution system. In eight years the actual property value, exclusive of all water rights in the Los Angeles River bottom, has been increased to $6,500,000. All this and much more has been accomplished from the sale of water for domestic use. The city's daily consumption now averages 35,000,000 gallons. With other towns which will draw on the new supply, in 1925 it is estimated 110,000,000 gallons daily will be required for domestic consumption at a rate close to the present one of nine and two-thirds per 1,000 gallons.

The new water supply at its full capacity can deliver 260,000,000 gallons every 24 hours into the San Fernando reservoirs. These, conserving the golden flood during the time of winter rains, when there is least demand, will assure a withdrawal of more than 300,000,000 gallons daily during the five months of the hot, dry summer season. It will thus be seen that much more than half of the aqueduct's capacity can be devoted to irrigation for a very long term of years.

In the San Fernando Valley and spreading out directly beneath the two great reservoirs, government reports show that there are from 60,000 to 75,000 acres of fertile lands which can be made highly productive if water can be brought to them. In the San Gabriel, the Cahuenga, and other valleys, this area is increased to more than 200,000 acres—an area furnishing a market for a larger amount of water than the city will have for sale for irrigation purposes. This several hundred square miles of territory, which for years has been included in a few great ranches, each comprising thousands of acres, is being broken up into small ranches averaging not more than 40 acres, in anticipation of the coming of waters.

These ranches five years ago could have been purchased at from $10 to $40 an acre, which is the average value of lands having no prospect of water. Today they are being sold in the San Fernando Valley at prices ranging from $60 to $200 an acre. Under irrigation and with citrus orchards in bearing, they will command prices ranging from $1,000 to $1,500 an acre, which in the citrus fruit belt is considered an average price.

The increase in the value of these lands has been brought about solely through the city's construction of the aqueduct. As yet Los Angeles has made nothing public concerning any plans it may have for the benefited area to pay a share in the cost of the aqueduct, but undoubtedly some means will be devised by which the territory will pay a just proportion, exclusive of the annual rental which will be charged for the water consumed. The lands, once brought under cultivation, will increase the assessed valuation enormously.

The discussion of electric power possibilities has been left for the last for the reason that it deals with revenues and possibilities of civic greatness which are larger than those of either domestic use or irrigation.

A SCENE IN THE HIGH SIERRA, WHERE THE WATER COMES FROM

A CITRUS ORCHARD IN THE SAN GABRIEL VALLEY, A FEW MILES FROM LOS ANGELES
This photograph was awarded the grand prize in the photographer's contest held by the Chamber of Commerce. Photograph taken January, 1910, by Geo. R. King, Pasadena, Cal.

SPLENDID POSSIBILITIES FOR ELECTRICAL DEVELOPMENT

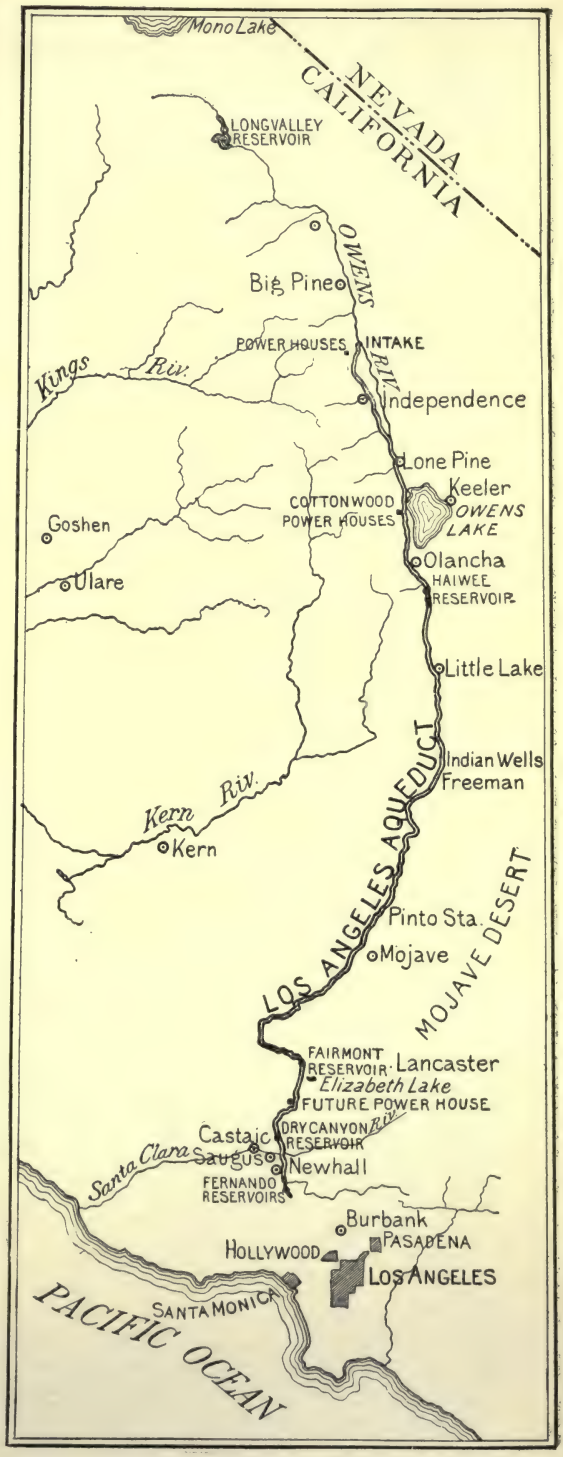
The total output of electric energy, in a report made March 4, 1910, by three of the foremost electrical engineers in the United States, is placed at 120,000 horse-power peak load. Of this amount, 80,000 horse-power can be developed within 50 miles of Los Angeles. April 19, 1910, a bond issue of $3,500,000 was voted by a large majority for the purpose of partially developing this large source of income, estimated at 49,000 horse-power. The hydro-electric plants are to be constructed and ready for operation at the same time that the aqueduct is opened to the flow of the Owens River.

The present consumption of power for all purposes in the entire county of Los Angeles is estimated as not exceeding 80,000 horse-power, of which 55,000 horse-power is consumed within Los Angeles city. It will require a long series of years to find a market for such a large amount of power as the city has at its back, and this is recognized by the development of only a fraction of the possible output just at this time.

Mr E. F. Scattergood, the aqueduct's chief electrical engineer, prepared estimates in 1906 for the development of 37,000 horse-power at a total cost of $4,490,000, the power to be delivered at the city's gates. With the sale of power figured at the low wholesale rate of eight-tenths cents per kilowatt hour, on a 50 per cent load basis, and accounting for all costs of operation, maintenance, interest on bonds, sinking fund, and depreciation of plant, he placed the net annual revenue at $1,406,000.

Mr Mulholland, in a public utterance on this subject, said: "I believe that the people have in the possible power development from the aqueduct an investment which 20 years hence will turn back into the city treasury the entire $24,500,000 provided for the construction of the aqueduct, with interest." His declaration is borne out by the hydraulic and electrical engineers who have been called upon to examine the plans and estimates.

Naturally a part of the surplus power will be taken through the growth of



manufacturing industry in Los Angeles, which has been phenomenal during the past decade. In 1900 the government industrial experts placed the city's manufacturing output at $5,000,000, and in 1905 at $30,000,000. This year Mr C. C. White, of the Census Bureau, in his preliminary investigations, places the total at $75,000,000.

With a cheap and abundant power such as the city will be able to offer, a constantly enlarging market must follow. Two hundred miles south of Los Angeles lies the Imperial Valley. Here for three years experiments in cotton-growing have been carried on. Last year's crop proved the industry a success, with a grade of cotton of a very superior quality. There were 1,000 acres under cultivation then; this spring 30,000 acres were set out to cotton plants. It will be remarkable if this new industry does not bring to Los Angeles likewise a new field for manufacturing. This is only one of the possible means of power disposal at which Los Angeles' commercial bodies are casting longing eyes.

For her own needs and for Pasadena and other cities and towns in the vicinity, electricity will be needed for street lighting, and in the construction of the municipal harbor at San Pedro another field awaits development of the magic juice.

These are lean years for the second metropolis of the Pacific Coast. She is straining every nerve and conserving every energy to meet the demands which her enterprise now makes upon her. With the spirit of the West, she has set out to accomplish, and, with the determination of the West, ultimately she will achieve. But, whatever the outcome and whatever the reward, certainly no municipality has ever waged a battle so remarkable in all its phases as this city by the Western sea.

GUATEMALA, THE COUNTRY OF THE FUTURE

By Edine Frances Tisdel

THE interest of the world is at present centered on the Isthmus of Panama and the wonderful work in progress there, so that in general little attention is paid, except by those commercially interested, to the adjacent group of small independent republics occupying the intervening space from Panama northward to the border of Mexico. They are apt to be thought of as countries continually torn by internal strife, devastated by earthquakes, and ravaged by disease—in fact, a sort of tropical wilderness scarcely worthy of a visit.

Never was there greater mistake. The beauty of the cities, the rapid extension of railroads, the cultivation and enormous proceeds of a wonderfully rich and fertile soil, all convince us of the progress of a people living amidst a wealth of scenic beauty and a perfection of climate rarely equaled.

This is particularly true of Guatemala, the most northern of the group, which, under the long and peaceful administration of President Estrada Cabrera, has been rapidly forging ahead to take its place on an equal footing with other nations of the world.

Three days' delightful sail from New Orleans to Puérto Barrios on one of the fine ships of the United Fruit Company brings us to these sun-kissed shores, where stately palms, stirred by perfume-laden breezes, wave in greeting.

The steady increase of American and German interests here is fast opening for our benefit one of the loveliest countries in the world, and the building of railroads is placing within easy reach the enjoyment of its natural beauties.

THE SUCCESS OF AMERICAN INDUSTRIES

All of the railroads are owned by an American syndicate and are absolutely under American control. From Puérto Barrios, on the Caribbean, the Northern road runs a distance of 224 miles up to the city of Guatemala, the capital. From here starts the Guatemala Central road, extending a distance of 74 miles to the port of San José, on the Pacific. The Guatemala Central Railroad has in all 216 miles of road throughout the country, and now in course of construction is a branch line 38 miles in length, to run from the city of Rétalhuleu to Ayutla, on the border of Mexico, to connect directly with the Pan-American road there. In a few months it will be possible to travel by railway from New York city to the capital of Guatemala.

This country was for centuries the home of the Maya-Quiché Indians, whose history reads like a romance. Cortez, however, after the conquest of Mexico, desiring to extend his power over the country farther south, in 1522 sent an invading army under the command of Pédro de Alvarado to subjugate this powerful race.

Leaving Mexico with some 300 Spaniards and a great number of Mexican Indians, Alvarado fought his way into Guatemala, overcoming all who opposed him, and finally, on July 25, 1524, founded the first Spanish capital under the name of Santiago de los Caballeros (Saint James of the Cavaliers). And so it happened that, in a beautiful valley at the foot of two great volcanoes, "Agua" and "Fuego" (meaning water and fire), was firmly established the Spanish rule which was to last for nearly three centuries—that is, until September 15, 1821, when Guatemala became an independent republic.

This first Spanish city was, however, 20 years later, almost completely wiped out of existence by a great flood of water which poured down upon it from Agua. There has been much controversy among scientists as to the origin of this flood. Some claim it to have been the result of a cloudburst, others that it came from the crater of the supposedly extinct volcano. The former supposition seems to be the most plausible, as research has so far failed to discover traces of a considerable body of water ever having existed in the crater.

The few survivors fled down the valley and at a distance of three miles chose the site of a new city, and, in 1542, courageously founded a second capital, now known as Antigua. In time it grew to have a population of 100,000 inhabitants, and became a great center of learning, with many universities, monasteries, and over a hundred churches rich in works of art. Although many times threatened by earthquake shocks more or less severe, it flourished until July 29, 1773, when, without warning, in one minute the proud city was leveled to the ground.

THE RELOCATION OF GUATEMALA'S CAPITAL

Again the survivors of this second calamity sought refuge farther away from the threatening volcano, and, at a distance of 35 miles, finally settled in the beautiful valley of Las Vacas. Here, at an altitude of 5,000 feet above the sea, surrounded on all sides by soft green hills, behind which loom the imposing heads of three volcanoes, lies the city of Guatemala, the present capital, founded by the courageous survivors of one of the greatest calamities in the history of any land.

This typical city of Spanish America is a most interesting and charming place to visit. Coming directly from the land of sky-scrapers, the first impression of it, with its low white buildings, is particularly attractive. Here and there is a house tinted a bright pink or a vivid blue, thus varying the monotony of the dazzling white and lending a sort of holiday look, as though the houses had put on their best gown to welcome the stranger.

The climate is one of perpetual spring, the average temperature being about 70 degrees. The summer months bring the heavy rains.

Although in a land of earthquakes,

BELLS TAKEN FROM CRUMBLING TOWERS OF CHURCHES DESTROYED BY EARTHQUAKE

this city has suffered little from them, only experiencing slight shocks from time to time. During my entire six months' stay in this country I did not feel even a tremor, and I really think that my friends were rather disappointed when I returned and was unable to give thrilling accounts of one of nature's upheavals.

With a population of 100,000 inhabitants, the city is laid out on a splendid scale, with broad avenues, fine parks, and handsome buildings. It is one of the best-lighted cities in the world. Street cars, little mule cars, run from one end to the other, and already a concession has been granted to an American syndicate for the construction of an electric line.

In the center of the city is the Plaza de Armas, with its pretty park, where stands the handsome statue of Columbus. This plaza becomes the rendezvous of fashion three or four evenings of the week, when an exceptionally fine band plays. Here also each morning at 10 o'clock a company of the President's Guard of Honor parades. Most interesting scenes are also witnessed on the nights of any national holiday or church festival.

The Indians come in from the surrounding country early in the day and install themselves in picturesque groups, selling native sweets, cocoanut water, and beautiful fruits. As night comes on they build fires which illumine their dark faces and brilliant costumes. The trees are hung with gay lanterns and at one side is stretched a great canvas upon which a free moving-picture show is in progress.

The band plays, and between times is heard the rather weird music of the marimba. This native instrument has a peculiar charm and, in spite of a certain metallic sound, not unlike a xenophone, when played in the open air has very beautiful tones. Often in the dead of night one is awakened by the plaintive tones of one of these instruments as some dark-eyed senorita is being serenaded.

The Cathedral, which stands facing the plaza, with its two square towers, is a fine example of the churches of Spanish America. A curious but not unpleasing effect is obtained in the interior by the blue-and-white ceiling. All the churches of the city are rich in wood carvings, paintings, and antique altar silver saved from the ruins of Antigua.

Throughout the country wherever the churches have suffered from earthquakes and the crumbling towers are no longer strong enough to bear the weight of the heavy bells, these are hung out of doors under a pointed thatched roof held by bamboo poles, which adds greatly to the picturesqueness of the landscape.

The Téatro Colon, the national theater, is a building of which any city would be proud. It is copied from the Church of the Madeleine in Paris. It is generously subsidized by the government, and good operatic and dramatic companies come from Italy, Spain, and Mexico. Bull-fighting is, of course, the favorite amusement, and there is a good bull-ring.

To the west of the city stretches the broad avenue of La Réforma, a beautiful drive several miles in length, shaded by great trees and containing some fine statues, the two most important being those of Gen. Rufino Barrios and Gen. Garcia Granados. At the beginning of the driveway stands the artillery barracks, a rather imposing building, and at the opposite end is the National Museum.

At the other end of the city is the wide boulevard leading to the hippodrome or race-course. Here we come upon the beautiful Temple of Minerva. President Cabrera believes in education, and under his enthusiastic directions there is no little town but has its public school. To commemorate the education of the youth of the country, he has set aside one day each year—the last Sunday in October—as a popular festival, and all scholars and teachers take part in the celebration, which is known as the Feast of Minerva. In each town of any importance is now to be found one of these temples.

LANDING PASSENGERS AT THE PORT OF SAN JOSÉ, ON THE PACIFIC

HOW GUATEMALA IS GOVERNED

The government of Guatemala is republican, the president's term of office being for six years. The legislative power is vested in a national assembly, which consists of one house composed of a deputy for each 20,000 inhabitants. Beginning the first of March, the annual sessions are held, lasting two months.

I well remember on the day of the convening of Congress that I expressed a desire of attending, as in other countries, one of the sessions. Had I dropped a bomb in the midst of the group who overheard the remark I could scarcely have caused greater excitement. "Impossible! Unheard of! Women did not go to Congress," etc.

The rumor spread, however, that the American girl wished to go, and a few days later my father received a gracious note from Señor Ubico, President of the Senate, inviting us to be present on a certain evening, for the meetings are held at night. Nearly a hundred members were present and several important bills were passed, among them one granting the concession for the building of the international bridge over the Suchiate River on the border of Mexico. It was most interesting and I had the honor of being the first, and, as far as I know, as yet, the only woman who has ever been admitted within the Congress Hall of Guatemala.

I was fortunate enough, also, through the courtesy of President Cabrera, to be shown the Palace, another place a woman has never been admitted to. Soldiers were drawn up and presented arms as we entered the large court, and we were met by one of the generals, resplendent in gold lace, whom the President had detailed to escort us. The wide white marble stairway, the reception rooms, and banqueting hall would bear comparison with many in the royal homes of Europe.

It was here that, on March 11, 1909, President Cabrera entertained Rear Admiral Swinburn, then in command of the American Pacific squadron, and some 30 of his officers. Never have I seen such

Indian Servants in Native Costume. Domestics receive $3 per month in Guatemala City

Indian Woman at Work in the Cotton Factory of Cantel

Indian of San Lucas. Costume of red and white stripes, the people resembling animated sticks of peppermint candy.

Little Indian Girl whose Name was Elvira Apolonia, known as "Apollinaris"

lavish expenditure as during the four days when our officers were this nation's guests. The city was gay with flags, flowers, and illuminations. The ball given by the city, and at which 800 guests sat down to supper in the beautiful "patio" of the Municipal Palace, was the most gorgeous affair of its kind I have attended.

These patios, or courts, are characteristic of the buildings, public or private, throughout the country. Here indeed a man's house is his castle.

The windows looking onto the streets are rarely opened, and for good reason. What in our country are known as sneak thieves here have an original way of obtaining their spoils. A long string with a fish-hook at the end is the instrument employed, and this, thrown in between the bars with a dexterity equal to the lasso-throwing of the cowboy, falls unerringly upon the chosen object, which in a twinkling is whisked away. Woe to the person who, leaving his things scattered around, goes out of the room without closing the window.

THE SELF-APPOINTED REGULATORS OF THE PUBLIC HEALTH

"The National Health Department," as it is amusingly nicknamed, is also most original. Sopolotes, or buzzards, are the scavengers of the land, keeping country and city scrupulously clean. One soon becomes accustomed to the long rows of these solemn but ungainly birds patiently waiting to pounce upon any morsel thrown out. Soap is their favorite dainty, and, as they are great thieves, it is impossible to keep a piece of this particular article unless well hidden.

Living is cheap here and housekeeping not difficult, particularly if one knows a little Spanish. The markets, besides being attractive and picturesque, are excellent. There is no fixed price for anything, and one soon learns to offer just half of what is asked. Then naturally follows more bargaining, and one finally gets the goods for at least two-thirds less than the original price. The servants are mostly Indians and are exceptionally good. They learn quickly, and with a little patience can soon be converted into model domestics. Their wages are about 50 pésos, or some $3 gold, a month.

MOVING PICTURE POSTER ADVERTISEMENT SEEN IN CARIB VILLAGE

The signs over the shops are sometimes puzzling and often amusing. I remember one in particular, which translated reads, "Milk from the cow's foot." It meant that the cow would be brought to the door and milked before one's eyes. Whether this improved the quality of the milk I was never able to determine.

The most original sign seen in Guatemala was a poster advertisement of a moving-picture show. This was on the wall of a native school-house in the Carib village at Livingston. It read:

> "Tonight, in the Practical School, the Life and Passion of Christ and *other comic* moving pictures."

THE ANCIENT CAPITAL OF ANTIGUA

In strange contrast to the modern city of Guatemala is the old ruined one of

TYPICAL STREET SCENE IN THE CARIB VILLAGE AT LIVINGSTON

In which the poster shown in the preceding picture was seen

Antigua, which I have mentioned, and which to those remaining only a short time in the country is the most important place to visit. It is preferable to ride, although one can drive in old-fashioned canvas-covered diligences. The earlier the start after sunrise the better, for the road as far as the Indian town of Mixco presents a most attractive scene, as hundreds of Indians are jogging into the city heavily laden with great loads of earthen pottery, fresh fruits, and vegetables for the market. Mixco is picturesquely situated, nestling at the foot of the mountains and commanding an extended view of the great Guatemala Valley, with the city almost at one's feet, and in the distance the sparkling blue waters of lovely Lake Amatitlan.

Leaving the highroad one turns into a narrow defile, and up and down hill follows an old Indian trail, sometimes completely shut in, again widening with glimpses of the mountains as range after range rises to the imposing heads of three great volcanoes—Agua, Fuego, and Acatenango.

I do not know of any place I have visited, not even Pompeii, which made such a deep impression upon me as this city of the past.

Nestled in a broad, fertile valley, the climate of which is unsurpassed, nothing can exceed it in solemn grandeur. Watched over by the giant Agua, which rises in one magnificent unbroken sweep to a height of over 13,000 feet, street after street stretches dazzlingly white in the brilliant sunshine. Not a sound breaks the silence which hangs like a pall over the place, and even the modern town of some 30,000 inhabitants seems dead, and a strange hush lies over all.

The quaint little pink hotel, with its flower-filled patio, the air heavy with the scent of roses, orange blossoms, and starry-eyed jasmine, is in keeping with the atmosphere of romance which pervades the place.

Of half a hundred churches still standing, those of the Cathedral, San Francisco, and Récollecion are the most imposing. Of the first-named enormous edifice, 300 feet in length, only the outer walls, pierced by 50 windows, and a few graceful arches remain of what must have been a wonderfully beautiful building. The bright blue sky looks down on a tangled mass of trees and flowers, and here in the midst of this sad reminder of past grandeur lives an Indian family, the roof of their outdoor kitchen supported by wonderfully carved pillars of wood.

A woman was kneeling in front of a large stone slab upon which she was pounding wet corn preparatory to making "tortillas," the flat corn cakes which, with black beans, is the staple food of the country. We were invited to stop and watch the process, and boxes and a dilapidated chair or two were brought forth from some mysterious recess for our comfort.

HAPPY CHILDREN OF GUATEMALA

GUATEMALAN GIRLS DRESSED FOR FIESTA

The picturesque corner, with the Indian woman in her native costume kneeling in the light of a flickering wood fire; round-eyed, staring children of all ages; dogs, chickens, and pigs innumerable; the exquisitely carved pillars etched against the gray background of ruined walls, and the delicate branches of a cherry tree in full bloom, giving the harmonious touch of color—all combined to make a picture never to be forgotten. As the twilight fell dark figures glided silently by, balancing on their heads large flat baskets of fruits for the morrow's market, and seeking a resting-place beneath the dim arches, where here and there heaps of corn husks showed that at night this grim pile was not untenanted.

The ruins of San Francisco are also most impressive, and from the crumbling belfry is obtained a magnificent view of city and surrounding country.

The beautiful ruins of Récollecion are the property of a German-American priest, who reaps great benefit from his gardens and coffee plantation, which he cultivates during his leisure hours. It seemed rather incongruous to see fat black hogs contentedly rooting under the shadow of these historical walls, but this "padre" is nothing if not practical.

Not far from here is the estate of "Pastorès," where there is a large flour-mill, the only one of its kind in this part of the country.

Three miles from the city are the beautiful warm sulphur baths of Médina and Cubo, to reach which one passes through great sugar plantations on roads in perfect condition, shaded by trees which, meeting overhead, form a cool green archway as far as the eye can see. Further on is Cuidad Viéja, the site of the first capital. All that remains of historical interest are the two crumbling walls of what was at one time the palace of the conqueror.

MISCO INDIAN ON ROAD FROM GUATEMALA CITY TO ANTIGUA

SCENE IN THE "VIRGINIA" BANANA PLANTATION OF THE UNITED FRUIT COMPANY: GUATEMALA

The plantation covers 5,000 acres and ships 300,000 bunches of bananas each year (see page 609)

CARIB WOMEN OF LAKE ATITLAN

INDIAN BOYS IN SCHOOL, ON LAKE ATITLAN

There is a school-house in every village. The government is doing its best to give the Indians some education, but the indifference of the parents and the difficulty of finding competent teachers handicap the work exceedingly.

INDIANS AT LAKE ATITLAN (SEE PAGE 621)

All the garments worn by these Indians are of native manufacture. The looms on which the handkerchiefs and shawls are woven are just the same as those pictured in the aboriginal Mexican manuscripts

DEVELOPMENT OF THE EXPORT TRADE

There is a fascination about this valley impossible to describe, and a spell seems to be cast over all who come here. It is difficult to tear one's self away and return to the busy life of the outer world, which in this country, however, can be seen to the best advantage on the great banana, coffee, and sugar estates, or "fincas," as they are called.

Bananas are grown almost exclusively on the Atlantic side. The largest banana plantation of the country is that of "Virginia," owned by the United Fruit Company of Boston. It covers 5,000 acres of land and exports annually 300,000 bunches of bananas, the total export from all sections of Guatemala being 1,500,000 bunches. The output of the United Fruit Company's Guatemala, Panama, Colombia, Costa Rican, and Jamaica plantations exceeds 22,000,000 bunches of bananas a year. The company has some 70 ships of from 3,000 to 6,000 tons running to the United States and Europe.

Almost the entire Pacific slope is given over to the cultivation of sugar-cane and the raising of cattle.

The best coffee is grown in the highlands at an altitude of from 1,500 to 5,000 feet.

THE COUNTRY'S PRODUCTION OF SUGAR

From the city to the port of San José, on the Pacific, the Guatemala Central Railroad passes the largest of the sugar estates. San José is the seaside resort of the country during the months corresponding to our winter, and here one finds a good hotel, fine bathing (although the undercurrent is to be feared), and a splendid iron pier some thousand feet long. The landing of passengers here is amusing to the onlooker, but far from reassuring for the ones concerned, who dangle helplessly in midair in a sort of iron cage, as steamers cannot come up alongside of the pier, and a small boat has to be the means of transfer.

But to return to the sugar. Shortly after leaving Guatemala City, the road follows for 15 miles the borders of Lake Amatitlan, where the Indian women of the city take advantage of the boiling springs which abound all along this body of water for their laundry work. At the town of Palin one is greeted by an extremely picturesque scene, for the train is besieged by Indians in gay costumes balancing on their heads large flat baskets of gorgeous tropical fruits—"forbidden fruit," indeed, to the traveler until thoroughly acclimated. I have never eaten such luscious pineapples as are grown here, besides many wonderful and delicious tropical fruits of which we of the North know nothing.

Here we are directly on the opposite side of Agua from Antigua and a magnificent panorama lies before us—on the right the fertile slopes of the great volcano, and before us the smiling, sunlit plain stretching away 40 miles to the blue waters of the Pacific.

Concépcion is perhaps one of the most interesting of the many large plantations. It covers 155,000 acres and produces each year 10,000 tons of sugar, 20,000 bags of coffee, besides many hundred head of cattle and thousands of bushels of corn. It belongs to a German syndicate and is valued at 1,000,000 marks ($250,000), on which it pays 15 per cent.

All of these estates have miles of private railroad, and a continual stream of little cars piled high with sugar-cane run from the distant fields to the factory. The process of sugar-making is interesting to watch from the very beginning, when the juice is crushed out of the cane by giant machinery. The dry fiber is then used to stock the enormous furnaces over which seethe and bubble huge caldrons of syrup. Boiled down to a soft mass like caramel, it is poured into shallow vats to cool. The unrefined sugar, of a dark-brown color, is commonly used throughout the country. It is called "panela," and is molded into half-round cakes, of which two together make a ball, and is then curiously wrapped in corn husks.

The dwelling-houses on all the estates are invariably comfortable, with wide, shady porches and every modern improvement and convenience, at night being lighted by electricity.

THE PLAZA AT COBAN, GUATEMALA

ONE OF THE MONOLITHS AT COBAN

Old Palace of the Viceroys: Antigua
Street Scene in Antigua, with view of the volcano "Aqua"

Street Scene in Antigua: Arch of Santa Catarina
Ruined Church of La Mercedes: Antigua

SKETCH MAP OF GUATEMALA

It was my good fortune to stay at several of these *fincas,* and none more lovely than Pacayal, a coffee plantation way up in the mountains at an altitude of 5,000 feet. It is a 30-mile horseback ride after leaving the railroad at the station of Cocales. We stopped over night at the Indian town of Patalul, where there is a new hotel, primitive but clean. We rode into this town at sunset to find ourselves in the midst of a real country fair.

It was an odd scene, the booths of bamboo and groups of dark-faced Indians squatting around camp-fires. The sound of bells and discordant music reached us, and as we came in front of the church a procession was just coming out, headed by a life-size figure of the Virgin, borne on the shoulders of women. It was the finishing touch to an already unusual scene, as it wended its way down the crooked streets between the fires, the twinkling lights of many waxen tapers and the crimson glow of the sunset heightening the already brilliant coloring of the native costumes.

THE CULTIVATION OF COFFEE AND THE INDIAN LABOR

Pacayal, an estate of some 8,000 acres, boasts some of the finest coffee in Guatemala. Coffee is not a natural product

INDIAN WRAPPING SUGAR BALLS ("PANÉLA") IN CORN HUSKS (SEE PAGE 609)
The half-rounded cakes on the right are unrefined sugar

ONE OF THE LITTLE INDIAN BOYS ENGAGED IN PUSHING THE LONG ROWS OF COFFEE BEANS BACK AND FORTH IN THE SUN: PACAYAL (SEE PAGE 615)

of this soil, having been introduced into the new world by a Spanish priest in Guatemala, who obtained the seed from Arabia. The trees are first raised in nurseries, and when a few months old are transplanted. A coffee field in full bloom, with its wealth of fragrant white blossoms, is indeed a beautiful sight. When ready for picking the bright red berries greatly resemble cherries.

When we arrived at Pacayal the Indians were still harvesting, the result of a good day's work being about three bushels of berries apiece. Each day these are weighed, the pickers receiving a check and being paid off in full every Saturday. They earn about seven or eight cents a day for twelve hours' work, besides a home, which consists of a bamboo hut. There is little discontent among these children of the open air, except when occasionally a bottle of "guaro," the cheap alcoholic drink of the country, is smuggled onto the estate. This is generally accomplished by some loving spouse, who travels under cover of the night and by stealth to the nearest village to obtain the coveted beverage for her liege lord.

As soon as picked the coffee is pulped to prevent fermentation in the pulp, which would stain the bean. From the pulper it goes into great fermenting tanks, where it remains from 24 to 48 hours, in order to take off the sweet, gummy substance which is on the hull. It is then washed and spread to dry in the sun on large asphalt terraces called "patios." When thoroughly dry it is put through a huller to take off the fine silvery skin, and is finally ready for the market. One bushel of berries gives ten pounds of cleaned coffee. The crop of Pacayal last year was 20,000 bags. Each bag is of 130 pounds.

We had many a delightful dance in the moonlight on these slippery patios, which at night make ideal ball-rooms.

Many children are employed all day in ceaselessly pushing back and forth the long rows of coffee beans, and at night brushing them under cover as protection from the dew. It was amusing to watch them, and we became much interested in one boy in particular as an example of what teaching and the influence of civilization can do. He had been brought to the *finca* a few years before from the mountains, where his parents were wild people, living upon raw things and knowing nothing of the uses of water except as a beverage. He had learned quickly, and during our visit was promoted to the dining-room as "assistant butler." Disliking the length of his hair, however, we attempted to cut it; but, as we only had finger-nail scissors, the result was somewhat startling. It gave his head a Marcel-wave-like effect unusual even among Indians, and from that time on he would have nothing more to do with us. His name was "Saie."

An early morning ride to the adjoining sugar *finca* of Saint Emilia was the most beautiful I have taken. Single file we picked our way through the dense tropical forest. A wilderness of giant trees linked together by trailing vines; a profusion of vari-colored orchids; a soft pink carpet of waxen begonia; great splashes of scarlet made by the peculiar blossom of the plantain, and here and there an enormous poinsettia bloom. Over all a tangled mass of blue-and-white morning-glories heavy with sparkling dew. Coming out suddenly upon the brow of a hill, we saw the white houses of Saint Emilia lying 1,500 feet below, like jewels in a green velvet case. Behind towered the mountains and in the distance sparkled the blue waters of the Pacific.

In this same part of the country, tucked still further away in the mountains, at an altitude of 8,000 feet and 40 miles from the railroad, lies the interesting city of Quézaltenango. In April, 1902, it was almost totally destroyed by an earthquake, which occurred at the same time as the wholly unexpected eruption of the volcano Santa Maria. Like the Italians who time after time fly in terror from the shadow of the dread Vesuvius and invariably return, so the people of this country only momentarily abandon their homes. In this city of

INDIANS ON THE ROAD TO QUEZALTENANGO AND CANTEL, CARRYING GREAT LOADS OF POTTERY AND FRESH FRUITS TO MARKET

INDIAN WOMEN OF CANTEL COMING FROM THE FOUNTAIN
These women make excellent workers in the cotton factory

some 23,000 inhabitants we find the unique sight of stately new buildings side by side with crumbling ruins. A partially successful attempt has been made to rebuild this once beautiful city.

The theater is, if anything, finer than the one in Guatemala City, but unfortunately stands dark and silent most of the time, as few companies venture so far from the beaten track.

The market here is unusually interesting, being the center of trade for this section of the country. In none other did I see such brilliant coloring as shown here by the costumes of the different tribes of Indians.

SCENES IN THE MARKET: QUEZALTENANGO

It was not far from here that I visited, at a place called Cantel, to my mind one of the greatest tributes to American energy and enterprise in the country. Nestled in a fertile valley is a large cotton factory, the only one of its kind in the republic. Think of a model factory, employing some 400 or 500 hands, where every bit of machinery used has been brought on the backs of Indians or mules. The factory hands are all Indians, mostly women and children, the dexterity of the latter being fairly astonishing.

To reach Cantel one must leave the railroad at the Indian town of San Félipe and ride 40 miles up into the mountains. We follow for several miles a level road bordered by lovely coffee *fincas,* the mountains looming ahead dark and forbidding but gradually softened by the light of coming day to a velvety, misty blue against the pale pink of the sky. The road winds almost completely around Santa Maria, which rises to the towering height of 11,000 feet.

As we drew nearer, what at first seemed to be soft, fleecy clouds proved to be clouds indeed, but of steam issuing from the great jagged crater in her side. From here the road begins to ascend, winding up, up, seemingly interminable, like a great white snake crawling into the very heart of the mountains. I was quite unprepared for the grandeur of the scenery, which surpassed anything I had yet beheld. Soft green valleys a thousand or two feet below; range after range of mountains rising on either side and looming in front like an impenetrable barrier; rushing, tumbling mountain torrents, falling hundreds of feet in

View of the Cotton Factory of Cantel, built by enterprising Americans 40 miles from the railway (see p. 617)

Church in the Village of Cantel. Adobe bricks spread in the sun to dry

Looms in the Cotton Factory of Cantel

Street Scene in the Village of Cantel

beautiful cascades; above all, the majestic head of Santa Maria lazily puffing out soft clouds of steam.

WHERE NATURE PROVIDES STEAM HEAT

Still further on the road for miles skirts the edge of a deep ravine, and, looking down hundreds of feet, one sees great columns of steam, rising geyser-like, at regular intervals. Along the way from every little crack and crevice in the rocks small puffs of steam also issue, and we suddenly shiver as the realization is borne in upon us that the path we so gayly pursue lies over the heart of a live volcano, which at any moment may again bring devastation and death to this lovely land.

Here and there were groups of sleeping Indians, huddled together wherever steam was coming from the ground. If one must sleep under the stars on frosty nights, it is surely convenient to find already prepared a system of steam heating quite equal, to all intents and purposes, to that which in modern homes is the cause of so much trouble and expense.

This is the great highway from the interior to the coast, and a never-ending stream of traffic moves constantly up and down, presenting a most interesting scene; chiefly Indians, heavily laden with every conceivable article: great loads of curious water-jars, earthen pottery, coffee, sugar, fruit, and vegetables. Then large droves of hogs and fifty or a hundred mules. Most interesting of all to me were the innumerable teams of oxen, patiently drawing great creaking loads of raw cotton destined for the far-away factory.

The lakes of Guatemala are not numerous, but are very beautiful. We have already glimpsed at Amatitlan, and, still further off, again up into the mountains, lies the crater lake of Atitlan, incomparable for beauty and magnificence of scenery.

To avoid the heat of the day—for the season was already advanced—we arranged to journey thither by night. The proceeding was a little unconventional and rather a shock to our native friends; but, then, anything was to be expected of "gringos," or foreigners. So just at sunset we mounted our mules at the station of Cocales and started gayly off on our 30-mile ride. Up and down hill, through the beautiful country bathed in moonlight; fording numerous mountain streams looking like cascades of silver; through silent Indian villages, where the inhabitants were all sleeping in the open air in front of their queer little bamboo huts. The only sound to break the silence which brooded over the land was the plaintive call of the whippoorwill and the occasional song of the nightingale.

ATITLAN, THE CRATER LAKE

At midnight we reached the borders of the lake, and at the village of San Lucas took a little steamboat that was in waiting to carry us across to the hotel on the opposite shore. The great expanse of water lay like molten silver in the moonlight, the mountains standing in serried ranks like giant sentinels to guard this treasure. A soft white haze hung over all, but not too heavy to hide the perfect outline of the two gigantic volcanoes, Atitlan and San Pédro, rising from the water's edge in one magnificent sweep to the height of 12,000 feet.

As we approached the shore a picturesque scene was revealed. The little hotel stood out white and clear against the dark background of the hill, and below, at the landing place, a group of Indians awaited our arrival, the red glare from many torches casting a lurid glow over the picture.

Owned by a German, whose business and pleasure it is to raise countless canaries, this little inn is one of the best in Guatemala. The office presents a unique appearance. From every corner comes the twittering of the tiny feathered inhabitants of many cages, and the walls are curiously papered from floor to ceiling with $50,000 worth of shares of a steamboat company, whose boats were to have plied the lake between San Lucas and Panajachel, but which failed almost

THE GREAT TURTLE AT QUIRIGUA

This is, perhaps, the most extraordinary of the monuments at Quirigua. It is a cube about 8 feet in diameter, and weighs about 20 tons. The carvings are grotesque representations of the human face and faces of animals

before it began. Easy chairs and hammocks lend a homelike look to the long vine-covered porches, and in this quiet spot the days slip by unheeded and one forgets the busy world beyond the towering hills.

By daylight the beauty and grandeur of the scene, although robbed of the charm and mystery of the moonlight, was none the less perfect.

Lying at an altitude of 5,000 feet, about 25 miles in length, this body of water has no visible outlet, although many streams empty into it. Its depth is unknown; no fish live in its icy waters. Here and there mineral springs bubble to the surface, and the shores are strewn with pumice and stones of volcanic origin. Eleven Indian towns, named after the Apostles, dot the shores, but by far the most interesting is the town of Atitlan, lying snuggled on a beautiful bay running inland between the two great volcanoes. The ground here is a mass of rocks and stones, undoubtedly the result of some volcanic disturbance, and these, loosely piled one upon the other, serve as walls for the huts, which are topped by thatched roofs. As one approaches, the first impression is that of a gigantic patch of huge mushrooms.

Here 10,000 Indians, descendants of the once poweful Quiché nation, live entirely to themselves, having an "alcalde," or governor, of their own tribe. Among them one sees more marked the peculiar and unaccountable resemblance to the Chinese, which is more or less noticeable in all of the Indians throughout the country. It is whispered that these people are fire-worshipers, but that civilization and religious teaching at one time penetrated to this far-away corner is evidenced by the ruins of a church, now standing empty and unused in the center of the town. The interior still contains some fine wood carvings and beautiful altar silver.

Never, even among the poor of Italy, have I seen so many children. We were at once surrounded by a throng of them, who accompanied us everywhere, chattering like a lot of monkeys.

The costume of these people is very effective against the dull gray background of rocks and thatched roofs. It consists only of a long piece of scarlet cloth wound tightly around the lower limbs and a loose white "guipele," or shirt. The women wear a scarlet ribbon or narrow piece of cloth wound through the braids and around the head.

Solola, a town of 15,000 inhabitants, and capital of the province of the same name, lies some 3,000 feet above the lake. Although a center of commerce, it affords little of interest to the visitor, except the magnificent view of lake and country. A large bare plaza, a ruined church, and a broad new avenue leading to a new school-house, which is painted a brilliant sky blue, are the chief attractions of the place.

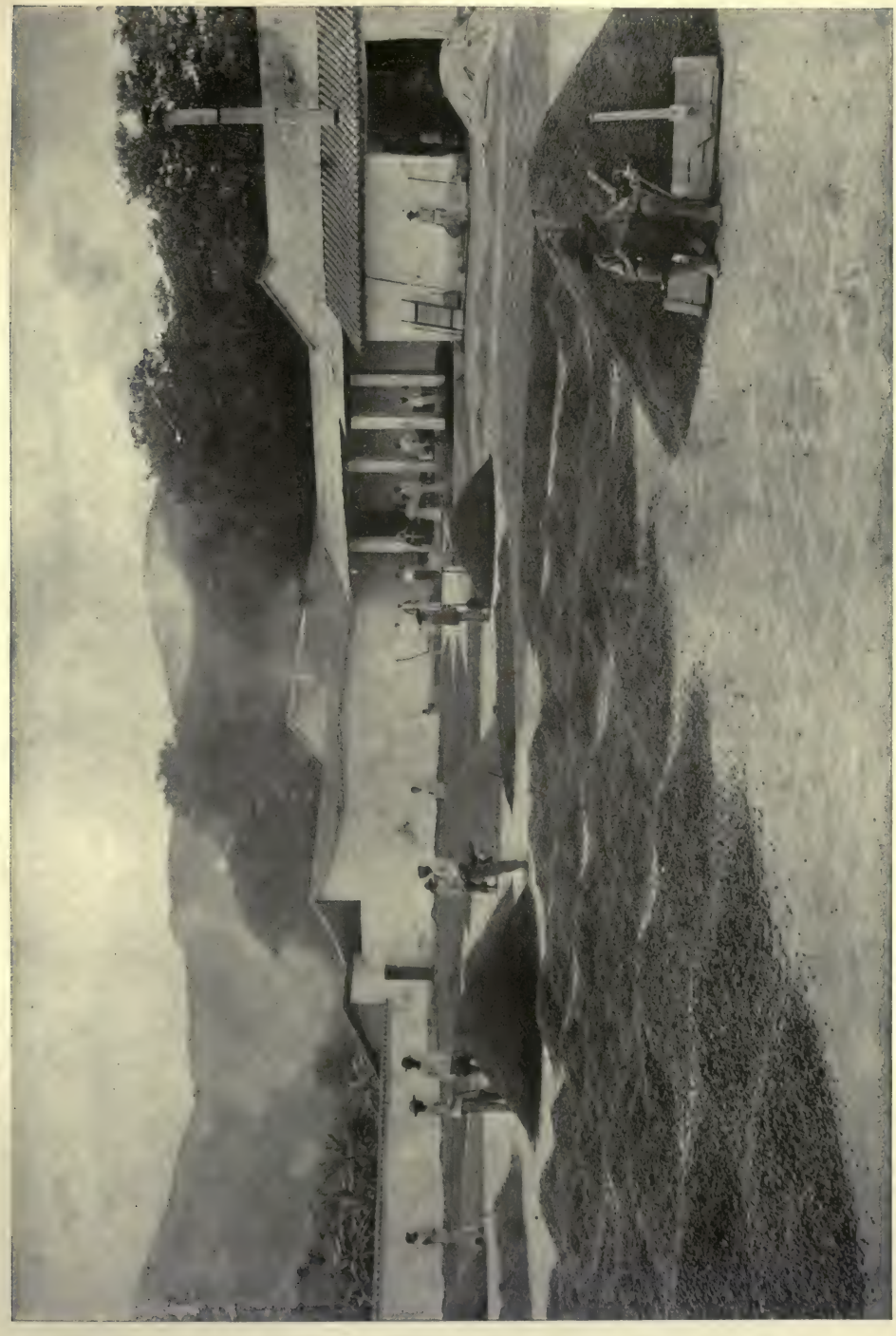
As we rode into the plaza a military band was playing, but upon our arrival the musicians hurried frantically to the end of the piece and then gave themselves up to staring open-mouthed at us. We dismounted and walked through the public gardens, a most melancholy attempt at embellishment, as the stiff flower beds were without flowers and the fountains, like the school-house, painted bright blue, were without water. The place was on the whole depressing, and, to raise our drooping spirits, we indulged in a two-step down the deserted central allée to the strains of a *Sousa* march—whether played in our honor as "Americanos" I do not know.

We were, however, well repaid for the ride. It has been my good fortune to look down upon many lakes in different parts of the world, but never have I had spread before me a more gorgeous panorama, earth, sky, and water outvying each other in deepest sapphire tones, and seven magnificent volcanoes dominating the wonderful scene.

Lake Yzabal is reached by a line of steamers, owned by a German syndicate, plying regularly between Livingston on the Caribbean and Panzos in the interior, on the Polochic River. For the first ten miles we follow the winding course of the beautiful Rio Dulce, or Sweet River,

ONE OF THE CARVED MONOLITHS OF QUIRIGUA, GUATEMALA (SEE PAGE 624)

None of these remarkable monoliths at Quirigua contain any carving or representation of a weapon of war, which is a proof of the advanced civilization and culture of the unknown people who constructed them. The illustration on this page and on pages 607, 608, 610, 611, and 620 are from "A Glimpse of Guatemala," by Anne C. and Alfred P. Maudsley.



DRYING COFFEE ON A PLANTATION IN GUATEMALA

renowned for its scenery, which is very like that of the far-famed Saguenay, in Quebec.

On each side perpendicular walls of green rise to the height of 300 to 400 feet, and at times so inclosed is it that it seems the boat must run in among the trees and overhanging vines. Then the river broadens and we come out into what is called the Golfete, a pretty body of water ten miles in length and dotted with numerous islands; through another narrow channel and out into the lake proper. Here stands the old ruined fort of San Félipe, built by the Spaniards in 1524 to guard the approach to the town of Yzabal, which used to be the principal port of the Atlantic coast. A sand bar, however, has formed across the mouth of the Rio Dulce, which prevents any large-sized vessels from reaching this inland sea.

Although of fresh water, many fish come up from the sea, and even shark are sometimes found here. Crocodiles are numerous, and "mantas," a species of hippopotamus, commonly called sea-cow, are also found. All the way up the Rio Dulce one sees by the hundreds the beautiful white "garza," the lovely bird from which is taken the much-desired and expensive aigrette.

Much further to the north, in a wild and sparsely populated part of the country, lies the lake of Peten, or San Andrès, of which, as yet, very little is known. On an island in the center of the lake is the city of Florès, known only to antiquaries. Here are many curious ruins and stone idols, the origin of which is as yet unknown.

There is a vast field for research in this country, where little is known of the races who were its first inhabitants. But that the ancient American civilization was highly developed is a fact beyond doubt, for the remains of numerous prehistoric cities have been discovered throughout Central America.

THE INEXPLICABLE RUINS OF QUIRIGUA

Among the most remarkable are the ruins of Quirigua, in Guatemala. Situated in the valley of the Motagua River, some 60 miles from its mouth, they are completely hidden in a thick tropical jungle, and consist of square and oblong mounds and terraces.

The chief interest, however, centers in several carved monoliths, three to four feet square and standing from 14 to 25 feet in height. The as yet untranslated hieroglyphics on these bear some resemblance to the Egyptian, although curiously enough the Greek cross can be also traced.

Many theories have been advanced as to the origin of the people whose wonderful works still stand amid the silence of the primeval forests, shrouded in the mystery of ages. There is, of course, much controversy, some ascribing to these ruins great antiquity, while others assert that they are of comparatively recent construction. No traditions have been found among the Spaniards or the Indians to shed any light upon the subject. The people who built them seem to have had a distinct, independent, and separate existence. Much attention has been given to the deciphering of these inscriptions, but still much remains to be done before the mystery will be solved. Some may date back 3,000 years or more, while the later dates on others of the Quirigua ruins may be assigned to a place at the beginning of the Christian era.

And so with the poet we can well say:

"World wrongly called the new; this clime was old
When first the Spaniards came in search of gold.
Age after age its shadowy wings have spread,
And man was born, and gathered to the dead;
Cities rose, ruled, dwindled to decay,
Empires were formed, then darkly swept away;
Race followed race, like cloud-shades o'er the field,
The stranger still to stranger doomed to yield."

Photo by Robert Shields

A NATIVE VILLAGE IN THE INTERIOR OF ANGOLA

ANGOLA, THE LAST FOOTHOLD OF SLAVERY

ANGOLA, the Portuguese colony on the West Coast of Africa, is a country about as large as France, Switzerland, and Italy combined. Its coast-line on the Atlantic is nearly 1,000 miles in length and has many good harbors. For every thousand people who have heard of the Congo Free State, which borders on the east and north, it is possible that two have heard of Angola, and perhaps one of those knows that from a time some score of years before the inauguration of the Congo State to the present day there has existed in that country a system of slavery which is only comparable with that of the Spaniards in the West Indies. Slaves are brought down from the far interior, often as far as 800 miles, by agents who think they have done well if one-half of their drove survive the journey. At the coast, knowing that it is impossible for them to return home, the slaves bind themselves to a term of service—"indentured labor," it is called—which never ends, and are shipped to the cocoa plantations of the islands of Saint Thome and Principe.

Angola is classed as a country poor in natural products of the soil and in minerals, but still moderately rich in men, in spite of having been squeezed for generations by the Portuguese. The principal agricultural products are manico, coffee, bananas, sugar-cane, and tobacco. The trade is mostly with Portugal, the chief exports being coffee, rubber, ivory, wax, fish, and palm oil.

The capital of Angola is Loanda, or

Photo by Robert Shields

A CHRISTIAN FAMILY OF LOANDA, THE CAPITAL OF THE COLONY

Saint Paul de Loanda, as it was christened, the oldest Portuguese settlement south of the Equator and once the center of the slave trade between Africa and Brazil. Its splendid harbor offers a safe haven, and it boasts of a mixed population of about 25,000. For administrative purposes the colony is divided into five districts, and at the head is a governor appointed by the Portuguese. The population is estimated at 5,000,000, the greater portion natives, and the number of Europeans being only about 4,000. They have, however, exercised a great modifying influence on the native population inhabiting the western part of the colony as regards their customs and economic condition.

Photo by Robert Shields

TWO NATIVE WOMEN RETURNING FROM THEIR FIELDS: LOANDA

The woman on the right has been carrying her baby strapped to her back while she worked in her own fields. Polygamy prevails among the natives, and every wife has her own house, garden, and private property.

A NATIVE HOUSE IN COURSE OF CONSTRUCTION IN ANGOLA

Photo by Robert Shields

NATIVES CRACKING PALM-KERNELS FOR THE MARKET: ANGOLA Photo from Bishop J. C. Hartzell

Photo by Robert Shields

NATIVE CHIEF WITH HIS PRIME MINISTERS AND A FEW OF HIS SUBJECTS IN ANGOLA

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THE NATIONAL GEOGRAPHIC MAGAZINE

THE SOUTHWEST

Its Splendid Natural Resources, Agricultural Wealth, and Scenic Beauty

BY N. H. DARTON, OF THE U. S. GEOLOGICAL SURVEY

THE southwestern section of the United States is a province that presents many special characteristics of physiography, climate, resources, and capabilities which are not as well known as they deserve to be. The term "Southwest" is usually applied to New Mexico, Arizona, and southern California, an area of about the size of New England, New York, Pennsylvania, Maryland, and the Virginias. Much public attention has of late been attracted to Arizona and New Mexico in connection with their admission to statehood, and one gratifying result of this has been a greatly increased interest in their resources and conditions.

Excluding the populous and thrifty coast region of southern California, the Southwest is the most thinly populated and least developed portion of the country south of Alaska. As this condition is due mainly to a climate so arid that but little can be raised without irrigation, its future development is to be measured by the utilization of the vast volume of flood waters now going to waste. This water can be applied to millions of acres of level lands with rich soil, which with the unending sunshine of its mild climate will respond with large and profitable crops.

Unfortunately, there is not enough water for all the land, but there is sufficient, if all were utilized, to support a population many times as large as the present one. The Government is now spending $12,000,000 in reclamation projects in Arizona and New Mexico, which will supply water for nearly one-half million acres of fertile lands. This will give great impetus to development, and in time, when settlers take up the reclaimed land, there will be a large increase in its agricultural productions.

In the great coast region of southern California, with a population of nearly 600,000, the principal product is the orange and other fruits, with a value of about $20,000,000 a year, while in the inland districts the mining industry is the largest source of revenue. Portions of the Southwest are richly productive of various minerals, notably those of copper, and recently southern California has become a heavy producer of petroleum. The value of the copper, oil, and other products of the ground aggregates about $75,000,000 a year.

It is probable that further exploration will disclose large additional supplies of ores of various kinds, especially those of low grade, which will prove profitable under improved methods of reduction.

MAP OF SOUTHWESTERN UNITED STATES

MOUNTAINS AND RIVERS

As shown in the map (page 632), the Southwest presents a variety of topographic features, and many of its economic resources are closely related to them. There is great range in altitude, with corresponding variation in climatic conditions. One of the most salient features is the wide high plateau of northern Arizona, which reaches an altitude of 8,000 feet. It is surmounted by various volcanic peaks, notably San Francisco Peak, which is 12,611 feet above sea level.

To the east this district merges into an irregular series of high plateaus, constituting the western half of New Mexico.

To the west and south it drops by huge steps into the great region of desert valleys or bolsoms of Nevada, western Arizona, and southeastern California. These deserts are wide long plains, lying between mountain ridges of varying lengths and heights, ridges which are all very rocky and mostly treeless and trend north and south.

Diagonally across southern California there extends the long curving ridge of the Sierra Madre and San Bernardino Mountains, between which and the ocean lies the large oval area known as the valley of southern California. This valley is the great citrus fruit district, and Los Angeles, Riverside, and the many other settlements lie on its gentle seaward slope.

There are two great rivers in the Southwest, the Colorado and the Rio Grande. The Colorado River has been compared to the Nile and the similarity is notable. Both are streams of the first rank, rising in high mountains, and finally crossing a broad region of semi-tropical, nearly rainless deserts. Both empty into seas in nearly the same latitude, and their lower courses are through wide deltas of fertile soil. The annual overflows add new sediments fertile with plant food and at a time favorable for the crops.

The agricultural capabilities are closely similar, but while much of the lower Nile Valley is utilized the Colorado Valley is just beginning to be settled. The watershed area of the Colorado, with its two head branches, the Green and the Grand, is over 200,000 square miles, its course 2,000 miles in length, and its annual discharge is 11,000,000 acre feet, or enough to cover that number of acres one foot deep.

The sediment which it carries each year into the gulf is estimated to be sufficient to cover 53 square miles one foot deep. For 200 miles of its course across the high plateau of northeastern Arizona it cuts the wonderful Grand Canyon, which in places is nearly a mile deep. South of the canyon it flows mostly in broad valleys, but cuts through several desert ridges, finally passing out into the wide delta plain extending to its mouth.

The Rio Grande is a large river rising in the mountains of Colorado, traversing New Mexico from north to south, and finally constituting the boundary line between Texas and Mexico. Its volume in central New Mexico varies from 200,000 to over 2,000,000 acre feet a year, with an average probably near 1,000,000.

THE DESERTS

The definition of a desert given by the dictionaries, "a dry sandy region without vegetation or inhabitants," is defective, and the idea that it is necessarily flat is erroneous. Most portions of the average desert bear an extensive, though somewhat widely spaced, flora. Many desert regions contain numerous settlements, the Sahara Desert for instance having a population of 2,500,000. Loose sand is a minor feature, and much more prevalent on the seacoasts and along the bottom lands of rivers. There are wide areas of bare rocks, and the larger deserts include mountains, ridges, mesas, and deep canyons.

The deserts of the Southwest are regions of very scanty rainfall, parts of them having only three inches a year and evaporation of eighty inches or more. Most of the rain descends in very heavy local storms which give rise to short-lived torrents, sometimes of great volume.

I have witnessed such storms, in some

Photo by J. K. Hillers

GRAND CANYON OF THE COLORADO AT THE JUNCTION OF THE LITTLE COLORADO, LOOKING EAST TO SHINIMO ALTAR: ARIZONA

The river flows 4,000 feet below the plateau

Photo by J. K. Hillers

GRAND CANYON OF THE COLORADO, NEAR THE HANCE TRAIL

Depth, about 4,000 feet, looking east

cases far in the distance, and as a result seen a dry wash suddenly fill with a stream 20 feet deep advancing in successive high waves. The flow would last a few hours, rapidly subside, and perhaps the wash would not be a water course again for several years.

The several large rivers that flow across deserts of the southwest accumulate their waters from melting snows and heavy rainfall in distant high mountains.

The temperatures in the deserts of the Southwest rise high in midsummer, often attaining 125 degrees in the lower lands of Death Valley and the lower Colorado Valley.

The desert vegetation is always a source of interest to the traveler, especially the varied and conspicuous cactus flora. The Saguaro (*Cereus giganteum*) of central and southern Arizona (page 651) is one of the most notable forms. It lives in areas where the precipitation is only three or four inches a year, but is restricted to the warmer districts. It has wonderful capacity for rapid absorption of a large amount of moisture, whether from a heavy downpour or a slight dampening.

The biznaga (*Echinocactus emori*), also known as watermelon or barrel cactus, is an associate of the Saguaro, and I can add my testimony to its usefulness as a most important water bearer. By cutting off its top and beating up the pulp with a stick one can secure a draft of watery juice of fair flavor which will effectively quench the desert thirst.

I once spent the month of November in the deserts of southeastern California investigating artesian waters for the Santa Fé Railroad, and the experience was one of the most delightful of my life. The climatic conditions were perfect, and the region was full of novel features of geology, flora, physiography and scenery which kept me greatly interested throughout the trip.

One must live awhile in the desert to realize its many charms. The brilliant sunsets are especially impressive, and the glowing twilights followed by marvelous effects of light and shade at nightfall piles great velvety shadows along the slopes of the mountains.

The Southwest, however, is rich in features that interest even the most casual observer. The most notable is the Grand Canyon of the Colorado, which is in many ways the greatest natural wonder in the world.

THE GRAND CANYON

This canyon is the mile-deep gorge cut by the Colorado River across the high plateau of northern Arizona. The view from the rim reveals the most stupendous panorama imaginable, for one sees into an area of about 600 square miles filled with an endless variety of most rugged topographic forms of many beautiful colors. On the sky-line, 10 to 15 miles away, is the edge of a wide-reaching plateau, and in the middle ground of the picture flows the Colorado River, nearly a mile below one's feet.

The features are so gigantic and so plainly in view that all sense of scale is lost, and it is not until one has been down to the bottom of the canyon at the river level that any adequate sense of proportion can be gained.

It is not a smooth-walled canyon of simple type, for, instead, the descent is by a succession of great cliffs and long, steep slopes, and the walls are an alternation of deep recesses and far-reaching promontories. Some of the latter are several miles long, and broken into irregular buttes of many forms.

The canyon is a most superb illustration of direct erosion, for the primary agency in its formation has been flowing water. The movement of talus down slopes, the action of frost, and the sculpturing by wind-blown sand have had an influence in the final details. Certain differential earth movements—faults and flexing—have also caused some modifications of contour. The configuration of the features in the canyon are closely related to rock texture; the great cliffs, many of them 600 feet high, and the plateau, are due to nearly horizontal limestones and sandstones of very mass-

Photo by J. K. Hillers

NAVAJO CHURCH, A PRODUCT OF EROSION IN CROSS-BEDDED GRAY SANDSTONE, EAST OF GALLUP, IN WESTERN NEW MEXICO

NAVAJO FALLS, ON CATARACT CREEK, IN HEART OF GRAND CANYON REGION: ARIZONA

The cliff to the left is about one-half mile high

ive character, while the slopes are mostly of shale and talus. The inner V-shaped gorge, 1,000 to 1,200 feet deep, in which the river now flows, is eroded in granitic rocks. The succession of strata presented in the canyon walls near El Toval Hotel is as follows:

Kaibab limestone.—Light-colored limestone, cherty in upper part, 700 feet.

Coconino sandstone.—Gray massive cross-bedded sandstone, 300 feet.

Supai formation.—Red shale and red slabby sandstone, 1,100 feet.

Redwall limestone.—Very massive gray limestone, mostly red on surface, 550 feet.

Tonto formation.—Slabby sandstones and greenish shales on massive basal sandstone, 700 feet.

The basal sandstone of the Tonto lies on granite and gneiss, of which over 1,000 feet are exposed, but locally on the opposite side of the canyon the Tonto is underlain by a mass several thousand feet thick, of Unkar formation, consisting of red sandstone, limestone, and basalt of Algonkian age.

The rim of the canyon near the hotel El Tovar has an elevation of 6,866 feet, and on the river bank below there is a U. S. Geological Survey bench mark reading 2,436, a drop of 4,430 feet. The river appears like a silvery thread when viewed from the rim of the canyon, but on going to the bottom of the granite gorge the river is found to be 250 feet wide, 20 to 30 feet deep, dashing along with a declivity of about 13 feet to the mile, and in places broken by strong rapids. One can then appreciate the heroism of Major Powell's famous trip down the river in 1869—a thousand-mile voyage in small boats through the entire length of this then unexplored canyon.

The canyon was discovered by Cardenas, who went to its edge in 1540 on a branch trip from Coronado's expedition, on information obtained by Tovar from the Hopi Indians. The original name given to the river was Tison, Spanish for firebrand, and it is to be regretted that the name has not been retained to avoid the present confusion due to the river having the same name as the state.

Formerly to reach the Grand Canyon it was necessary to stage 60 miles across the plateau, but now there is a branch from the Santa Fé railroad at Williams which takes the tourist to the fine hotel El Tovar, built on the brink of the canyon at one of the best view points.

SOME NATURAL WONDERS

Coon Butte, another of the greatest wonders in our country, is also situated in the Southwest, but owing to its distance from the railroad it is seldom visited. It is a great crater-like bowl in the plateau, about 10 miles south of Canyon Diablo station. The "crater" is about 4,000 feet wide and 600 feet deep, with an irregular encircling rim of loose rock fragments from 120 to 160 feet high. The wall of the depression shows broken-off edges of sandstones and limestones considerably upturned, and the rim consists of the ejected material. Some have advanced the theory that the features are due to the impact of a huge meteor, and a mining company has spent large sums drilling holes to find the iron or other meteoric material, but without success. Mr Gilbert's suggestion that the cause was a great volcanic steam eruption is much more plausible, however, for there are numerous volcanic vents at no great distance.

The petrified forests attract many visitors, especially the most accessible one south of Adamana, a station on the Santa Fé railroad a few miles east of Holbrook. There is a large quantity of the material in sight here, some of it in large logs. One of these logs spans a small draw as a natural bridge.

Arizona possesses a very picturesque natural bridge of limestone spanning Pine Creek, in Gila County, 70 miles south of Flagstaff. It does not, however, rival the great bridges recently discovered in Utah. Its span is 80 feet, its height about 125 feet, and its length up and down the creek is over 400 feet.*

Canyon de Chelly is one of the most notable scenic features in Arizona (see

* See "The Great Natural Bridges of Utah." By Byron Cummings, pp. 157-167, NAT. GEOG. MAG., February, 1910.

Photo by J. K. Hillers

CLIFFS AND PINNACLES OF RED SANDSTONE IN CANYON DE CHELLY, NORTHEASTERN ARIZONA

Note the man at foot of high pinnacle

CAPTAINS OF THE CANYON: 600-FOOT CLIFFS AND PINNACLES OF RED SANDSTONE IN CANYON DE CHELLY, NORTHEASTERN ARIZONA (SEE PAGE 639)

A CINDER CONE NEAR SAN FRANCISCO MOUNTAIN Photo by G. K. Gilbert

The product of very recent volcanic outbursts, rising over 200 feet, and just as fresh as if made yesterday

page 640), but it is so far off the main line of travel that it is rarely visited. It is cut deeply into soft sandstones, which rise in vertical walls, with many outlying pinnacles and monuments. Some of these features appear also in the great wall of red sandstone on the north side of the wide depression through which the Santa Fé railroad crosses the continental divide east of Gallup. One of the most remarkable pinnacles of this wall is fancifully termed the Navajo Church, shown on page 637.

THE FORESTS

Few persons who travel across the Southwest realize that in Arizona and New Mexico there are enormous forests of valuable timber and that the lumbering is an important industry. In both territories there are several large forest reservations, and one of these in Arizona, the Coconino Forest, with nearly 6,000 square miles, is the largest single reserve in the United States. The total forest area reserved in Arizona is 15,250,130 acres, or more than 24,000 square miles, and in New Mexico there are 10,971,711 acres, or more than 17,000 square miles. Southern California also has several large reserves.

The Coconino Forest in Arizona occupies part of the great plateau in which the Grand Canyon is cut, and extends to the brink of the canyon. It covers a wide area about San Francisco Mountains, and extends southeastward for 200 miles along the south edge of the plateau to New Mexico. Its extension in that territory is known as the Datil and Gila reserves, comprising 4,652,450 acres, the largest reserved area in the country. There are other large reserves in various portions of both territories.

The principal tree in these forests is the western yellow pine, and not the white pine, as commonly reported. Its lumber is only of moderate value as compared with high-class woods, but its local importance is very great. The trees grow from 80 to 125 feet high, and many of them 3 feet in diameter. In 1908 this pine constituted 96.5 per cent of the lumber cut in Arizona and 87.7 per cent of the cut in New Mexico.

There is now great interest in the cultivation of Eucalyptus in California, and many large groves have been started as a business enterprise. Several varieties of the tree were introduced many years ago, and most of them show remarkable growth and high value for many purposes. One of the railroad companies has planted about 4,500 acres to raise trees for ties, piling, and other uses. In some cases a tree will attain a height of 100 feet in six years, but some of the more rapid growing varieties have less satisfactory timber than is obtained from those of slower growth. One good feature of the tree is that it will grow on soils that are of but little value for agriculture.*

THE INDIANS

The visitor to the Southwest usually takes keen interest in the Indians, who are numerous not only along the main lines of travel, but in many remote villages. Some tribes, notably the Apaches, who continued to be troublesome until a relatively recent date, have become famous for the misdeeds that materially retarded the development of Arizona and western New Mexico. Now, however, all is peace and tranquillity. The newspapers, especially Eastern ones, occasionally print accounts of uprisings, but these prove to be local quarrels with a few individuals.

The Indians of the Southwest are of two kinds, differing greatly in most of their characteristics: One is the nomad type, represented by the Apaches, Navajos, the Yumas, Papagos and Pimas, and smaller tribes; the other is the pueblo type, which is comprised in 26 pueblos, or villages, scattered through central and western New Mexico, and in the Hopi Reserve, in northeastern Arizona.

Probably there is greater popular interest in the pueblo people, for their settlements are permanent and mostly very ancient, and their religious ceremonies are extremely elaborate and picturesque.

* See NAT. GEOG. MAG., July, 1909, pp. 668-673.

They live in villages of several hundred inhabitants, in substantial stone or adobe houses, some of which are in groups, rising in tiers to a height of four or five stories, with streets and central plaza. They are peaceful and industrious, raising crops largely by irrigation. They have herds of cattle and sheep, and spinning, weaving, and making their garments is one of their important occupations.

Work appears evenly divided between man and woman in the pueblos. The men do the farming, tend to the cattle and sheep, do the hunting, build the houses, and have many smaller trades and occupations. The women do the housework, grind the corn, make pottery, blankets, and clothes.

The visitor is generally impressed by the pueblo people, and pleased with the agreeable home life and the simple hospitality which they readily offer.

Zuñi is notable in this respect, and although it is far out of the usual line of travel it well repays a visit. The houses are built of adobe—bricks of sun-dried clay—and rise in tiers on the hill slope, as shown on page 652, so that in many cases the roof of one is the front yard of the next. All are provided with windows and doors, and inside there are clean whitewashed walls and fairly high ceilings, supported by long stout logs. The floor is adobe, smooth and clean. At one corner is an open fireplace, but cookstoves are not uncommon. The furniture consists of chairs and board tables, while for beds skins are spread on the floor. At night kerosene lamps give light. One can spend a very pleasant evening in such a home with the bright cheerful Zuñi men and women, and find the conditions quite equal to and even better than the standard of the lower-class ranches of the West.

Many visitors go to the Hopi villages, 75 miles northwest of Holbrook, to witness the snake dance and other ceremonies, and Zuñi, Taos, Acoma, and other pueblos are occasionally visited by the sightseers. Laguna, on the Santa Fé Railroad, a few hours west of Albuquerque, is the best known by sight, for all of it is visible from the train.

The elaborate religious beliefs and observances of the Indians of the Southwest have been the subject of many volumes, and although some of the Christian churches claim a few converts, the simple people of the pueblos prefer to cling to their own ancient traditions.

In earlier days, long prior to the discovery of the continent by Europeans, the Southwest was occupied by a large population of agricultural people, with extensive settlements in many of the valleys. We now find ruins of the villages, traces of their irrigation works, and old hiding places among the cliffs, which throw much light upon their character, occupation, and history.

The pueblo people of the present appear to be their descendants, but they are only a handful compared to those of the earlier times. It is evident that they were victims of the predatory Indians from the North, notably the Apaches, and there are many traditions among the surviving tribes of the ruthless warfare which their ancestors suffered.

TOURISTS

The interesting features of the Southwest, notably the beauty of the coast region and the special climatic advantages, draw a large number of tourists and health-seekers, especially in winter, and every year sees a substantial increase in the influx of visitors.

Southern California is the principal destination, and Los Angeles, Pasadena, and the beach resorts receive a great throng of sightseers. Many of them also go south to San Diego and the nearby Coronado Beach, where the magnificent Del Coronado Hotel delights the visitor. Others content themselves with a visit to Los Angeles and Pasadena and go north through Santa Barbara and other places to San Francisco. Phœnix, Arizona, receives a moderate share, notably of the health-seekers.

The conditions of travel and living in the Southwest are similar to those in most other portions of the West. Two

OSTRICH ROCK: AN EROSION FEATURE IN THE PETRIFIED FOREST OF ARIZONA

great railroad systems cross the country from east to west—the Santa Fé in the north and the Southern Pacific in the south—with various branch lines in different directions. Hotels are plentiful along the main lines of travel and throughout the valley of southern California, but especially noteworthy are the high-class mission-style hotels of the Harvey system strung along the Santa Fé lines in Arizona and New Mexico.

THE SOUTHWEST FOR HEALTH

Because of its dry air and mild climate, the Southwest has become famous as a health resort, especially for those having tuberculosis of the respiratory organs. The percentage of cures made in New Mexico, Arizona, and California, great as it is, would be much greater if a larger proportion of those who are seeking health came in time. It is necessary to come before the vitality is too greatly diminished and then to live under favorable conditions, the most essential of which is to be out of doors as much as possible.

"Lungers," as such invalids are termed, are not welcomed in the cities and larger settlements, and some hotels will not receive them, but there are many special resorts, such as tent colonies and sanatoriums for them. In the smaller villages and through the country there is usually no difficulty in securing accommodations.

Unless the affected person has some means to invest in a place of his own he is at considerable disadvantage, for it is difficult to obtain suitable employment. Living expenses are somewhat higher in the Southwest than in the central and eastern states, especially in the larger cities. Very little provision has been made for indigent consumptives, and many sick persons without means suffer great hardship in trying to sustain themselves after coming to the Southwest.

CAVERNS IN THICK DEPOSITS OF PURE ROCK SALT ON BANK OF SALT RIVER, IN MOUNTAINS OF CENTRAL ARIZONA

Note the man in upper left corner

Many health-seekers spend most of their money in railroad fare to reach the desired resorts. Physicians do a great wrong to patients in sending them so far from home, friends, and care without means to provide suitable quarters, nourishment, and attention to sustain them while making their fight against death.

It is found that different climatic conditions have important bearing, some persons deriving greater benefit from the dry cool highlands, while others prefer the lower deserts or the moister seacoast. In most cases the high summer temperature of the lowlands is too debilitating, and it is necessary to go into the highlands for the summer.

The Government has established a marine hospital at Fort Stanton and an army and navy hospital for consumptives at Fort Bayard, both in the highlands of New Mexico.

CLIMATE

The climate of the Southwest presents considerable variety, but in all the lower lands the winters are delightfully mild, and everywhere blue sky is in evidence for more than 300 days in the year. The summers are warm; in the southern desert area they are decidedly hot for several months, but the dry air even then is much more endurable than the sultry summer weather of the eastern and central states. Sunstroke is unknown, and laborers continue their work without distress.

While the temperature in the deserts of southern California and Arizona often rises to 120 degrees in the shade, if perspiration is sustained by plenty of water, the average person suffers no great inconvenience. Most of the nights are decidedly cool excepting in the lower lands farthest to the south.

The conditions in the deserts are well illustrated by the following table of monthly temperatures and rainfall at four typical desert stations.

On the higher lands of Arizona and New Mexico the summer weather is altogether agreeable, and in southern California west of the mountains the summer temperatures are moderate owing to the sea breezes which are nearly always in motion. The table on page 650 gives the average weather conditions, 1897-1909, at Redlands, California, which is typical of much of the coast region of southern California.

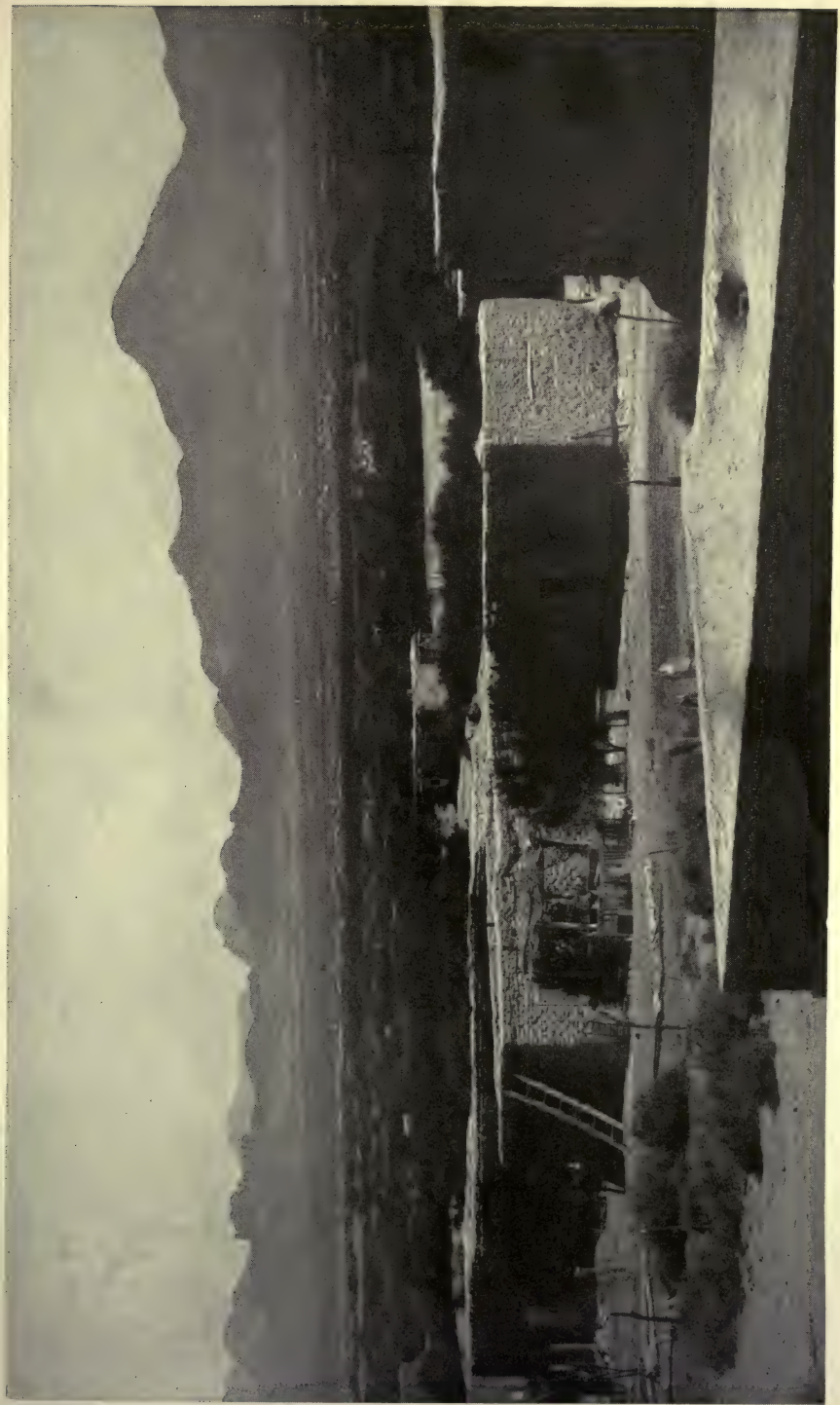
Temperatures and Rainfall in Desert Regions in the Southwest.

	Fort Yuma.			Phœnix.			Tucson.			Mohave.		
	Max. temp.	Min. temp.	Mean rainfall.	Max. temp.	Min. temp.	Mean rainfall.	Max. temp.	Min. temp.	Mean rainfall.	Max. temp.	Min. temp.	Mean rainfall.
Years observed.	26	26	20	17	17	22	6	6	15	5	5	26
	°	°	*Inches.*	°	°	*Inches.*	°	°	*Inches.*	°	°	*Inches.*
January.....	81	22	.42	87	12	.80	80	17	.79	70	16	.95
February.....	91	25	.61	92	19	.70	83	17	.90	78	20	.92
March.....	100	31	.26	97	24	.58	92	22	.77	83	26	.75
April.....	107	38	.07	105	30	.30	30	95	.28	100	35	.17
May.....	112	44	.04	113	35	.13	102	32	.14	102	38	.03
June.....	117	52	T.	119	33	.10	112	48	.26	107	48	.05
July.....	118	61	.14	116	46	1.03	108	59	2.40	115	64	.08
August.....	115	60	.35	116	49	.88	109	57	2.60	112	57	.04
September.....	113	50	.15	114	39	.64	107	49	1.16	104	45	.07
October.....	108	41	.28	105	34	.37	98	29	.64	93	40	.25
November.....	92	31	.29	97	24	.54	90	21	.81	84	27	.40
December.....	83	24	.46	95	18	.86	83	10	1.00	70	15	1.26
Year.....	118	22	2.84*	119	12	6.93	112	10	11.74	115	15	4.97

*26 years' observation.

SAND DUNES IN THE COLORADO DESERT OF SOUTHERN CALIFORNIA (SEE PAGE 633)

Photo by W. C. Mendenhall



DONA ANA MOUNTAINS, CENTRAL NEW MEXICO, FROM TOWN OF DONA ANA
Typical Mexican adobe residence in foreground

Average Weather Conditions at Redlands, California, 1897–1909

	Mean humidity.	Mean temperature. Max.	Min.	Daily.	Average rainfall.
January....	43	63	40	52	2.64
February...	48	66	42	54	2.37
March.....	42	70	43	56	3.08
April.....	32	74	47	60	1.85
May.....	44	76	50	63	1.76
June.....	36	88	54	71	.17
July.....	26	95	58	77	.01
August.....	27	95	59	77	.16
September..	28	90	56	73	.27
October....	33	81	50	66	.74
November..	35	72	45	58	1.04
December...	32	67	41	54	.95
Total for the year.....					15.04

Only 16 per cent of the days are cloudy and rainy. The rainy days average but 15 in a year. During all these years the temperature has exceeded 100 degrees in July, August, and September on an average of only fifteen times a year, and has fallen below 32 degrees on an average of less than three times a year. The wet bulb thermometer is usually less than 20 degrees below that of the dry bulb. The lowest recorded temperature of 25 degrees was only reached twice. January, February, and March are the wettest months.

The valley of southern California is protected from the cold northern winds of winter by high mountain ranges, while to the south it is open to the Pacific. Owing to the peculiar configuration of the coast the cold California current from the north is deflected west near Point Conception, and hence the southern California shores have waters warmer by about 10 degrees than those to the north. Then, too, the mountain barriers afford protection from the heat of the dry hot deserts to the east, and they cause precipitation which affords running water in fair volume in many streams. These mountains are so high that the winter snows linger on them far into the spring, when southern California is gay with its innumerable flowers.

FRUIT OF SOUTHERN CALIFORNIA

This beneficent climate is responsible for the giant industry of fruit growing which has made California famous over the globe. California furnishes the major part of the very large amount of oranges and other citrus fruits consumed in the United States, and this business has been the potent cause in the development of southern California. Ever since the early days of settlement it was known that climate and soil were favorable, but it was not until about 20 years ago that the great orchards were developed. The splendid success of the business led many to engage in it, until finally most of the available land came under cultivation.

There are two important natural limitations to the extension of orange culture—one is lack of water; the other is frost. Water for irrigation is a necessity, and as the available supply is limited only a certain acreage can be utilized.

At an early period all the surface waters were taken out in ditches, and then the underground waters were tapped by numerous wells. Storage dams have helped to conserve the surface waters somewhat, but the artesian supplies have been drawn on beyond their capacity for replenishment, and they are steadily diminishing in some districts of large extent.

A few years ago hydrologists of the U. S. Geological Survey made a careful investigation of the amount of underground waters available, and placed the data on maps and diagrams which will afford a definite basis for the water conservation. There are frequent lawsuits concerning underground waters, most of them brought by the man with the little pump when he finds that the company with the large pump is drawing away his water. There are about 3,000 flowing wells and 7,000 pump wells now supplying water for irrigation, with an estimated total volume of about 500 second feet.

The area of agricultural land in the fruit district is about one million acres, of which about one-fourth have water for irrigation and are cultivated. The remaining three-quarters is without water. The new water supply for Los Angeles will be about 260 million gallons

GIANT CACTUS (SAGUARO) OF REMARKABLE FORM ON DESERT SOUTHEAST OF PHŒNIX, ARIZONA

THE PUEBLO OF ZUÑI, IN WESTERN NEW MEXICO

Photo by J. K. Hillers

a day, or ten times as much as is now needed, and the surplus will be used for irrigation until it is required by the city.

The orange and other citrus fruits of southern California have an output of about 30,000 carloads a year, with a net value of more than $15,000,000. Of this, Riverside ships 4,000 to 5,000 cars of oranges, worth $2,000,000 net. Redlands' shipments in 1909 were 4,551 cars of nearly 2,000,000 boxes, valued at $2,764,000. Olives are also a prominent crop, yielding a large aggregate return. Besides her fruits, California raises a great variety of nuts and vegetables. The single item of walnuts sums up $1,500,000 a year. Lima beans, $2,000,000; celery, $600,000; potatoes, $225,000, and hay, $3,600,000, are very profitable crops. Dairy products, including butter, at $1,500,000; cheese, $320,000, and eggs, $750,000, are important sources of revenue to the farmers.

IMPERIAL VALLEY

East of the mountains in southern California is an extensive desert country, much of it without water, but large areas can be reached by ditches from the Colorado River. The most notable district of the sort is in the Salton Desert, near the Mexican boundary. A few years ago this was a lonely and forbidding region, but now, by aid of irrigation from the Colorado River, it has several thriving settlements, with 100,000 people and 200,000 acres of cultivated land. That portion of it known as Imperial Valley has the greatest development, and with rich soil and semi-tropical climate phenomenal results have been obtained when water was applied. The overflow of the Colorado River in 1906 delayed progress somewhat, but there is no prospect of a recurrence of a disaster of this sort.

One of the best known products of this region is the canteloupe, of which the annual shipments are over 1,800 cars, bringing nearly a million dollars. This valley contains over 400,000 acres of land, and just across the Mexican line are 200,000 more.

SALT RIVER VALLEY

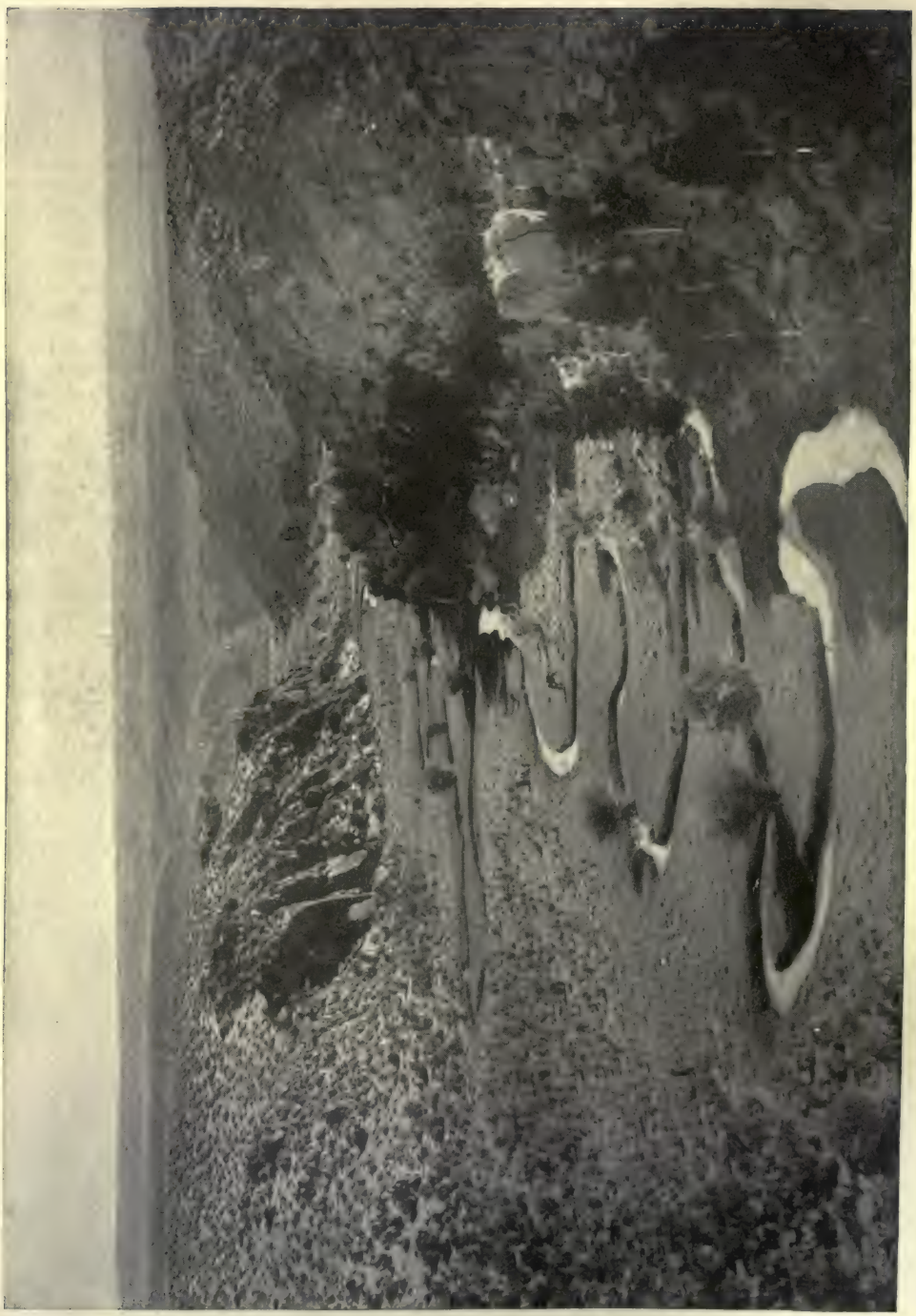
Salt River Valley is the "promised land" of Arizona. It is a very broad, level valley, extending east and west near Phœnix, and lying along both sides of Salt River, a stream which has a large watershed in the mountains of eastern Arizona. The valley is 50 miles long by 15 miles wide, and contains about one-half million acres of very fertile land, of which some 50,000 acres are now under cultivation by canals and pumping.

Normally the valley is a desert, for the rainfall is only from 6 to 7 inches a year, but the river water has been used for irrigation to some extent, and many wells afford supplies for irrigation of small areas. When the great Tonto reservoir is filled there will be sufficient water for 200,000 acres, and cheap power to run pumps to utilize the underground waters more fully for irrigation of an additional area of about 50,000 acres.

The dam across Salt River, erected by the Reclamation Service at Roosevelt for the Tonto reservoir, is 280 feet high, 1,080 feet long on top, with a total contents of 300,000 square yards. It required over 240,000 barrels of Portland cement, which was manufactured by the Government on the dam site. The reservoir, with an area of 25 square miles and a capacity of 284,000 acre feet, is the largest artificial lake in the world. Forty miles below is a diversion dam by which the water is taken out into great canals on both sides of the river that convey it to the valley lands, 15 to 30 miles below. These works will afford a large flow at times, when the water is needed for irrigation. The reclaimed land will cost the settler only about $30 an acre.

The principal product of Salt River Valley is alfalfa, but considerable grain, fruits, and vegetables are also raised. Alfalfa is cut from four to five times a year, with yield of four to six tons an acre, and it sells, baled, for from $8 to $12 a ton. Wheat yields 30 to 40 bushels to the acre.

Sugar beets have been tried in recent years with most satisfactory results, and



CROOKED CREEK, LONG VALLEY, CALIFORNIA: FLOWS IN A FLAT-BOTTOMED CANYON CUT IN THE WIDE DESERT PLAIN

Photo by W. T. Lee

SALT RIVER VALLEY, SOUTH OF PHŒNIX, ARIZONA, SHOWING INTENSIFIED FARMING BY IRRIGATION

TYPICAL ARTESIAN WELL AT ROSWELL, NEW MEXICO

There are hundreds of these wells supplying water for irrigation (see page 657)

40,000 acres of them were planted in 1908, with yield of over 20 tons to the acre. A factory has been erected at Glendale by a Colorado firm, which has a million dollars invested in the industry. The sugar averaged 16 per cent, and a two-months' run of the factory yielded 6,000,000 pounds of sugar.

Choice canteloupes are being raised in increasing number, and in 1908 125 cars were shipped East and West to a ready market. Olives and dates are being produced, and of late the orange business has begun to thrive rapidly, because the fruit can be raised to reach the markets in November and early in December, so that it commands extra high prices. One hundred carloads went East in 1907 at $5 to $8.50 a box, which yielded a profit of $500 to $800 an acre. All the garden products are raised profitably.

I know of one patch of strawberries near Tucson which returned $1,000 an acre net, and many yield $500 to the acre. Sweet potatoes are raised with returns of $300 per acre. Cotton has proven a success in southern Arizona, and it is remarkable in having fiber so long that special gins have to be made for it.

YUMA REGION

Yuma, in southwestern Arizona, is situated in the low-lying delta region of the lower course of the Colorado River, with its wide stretches of fertile soil and warm climate. The yearly rainfall averages less than 3 inches, but the waters of the great river are available for irrigation, and the operations of the Reclamation Service will furnish a water supply for 79,000 acres. The principal work has been the great Laguna dam built across the river, 4,780 feet long and 19 feet high, to create a reservoir of 10 square miles, with a capacity of 26,650 acre feet and an annual discharge of 11,000,000 acre feet.

The agricultural capabilities of this region are wonderful, for the soil is rich and the climate warm. A great variety of crops has been introduced, from dates to cabbage, and the returns have been phenomenal.

There are many private irrigation projects in various valleys of Arizona, and the next few years will witness the reclamation of a large acreage of land ready for the settler. It is probable that in time all this land will be under cultivation, and central and southern Arizona will be a great producer of useful crops.

NEW MEXICO AGRICULTURE

Irrigation has been practised for many years in New Mexico, but until lately the product was not large and it was consumed at home. In the past few years operations have been extended greatly in all parts of the country, and now the value of the crops exceeds $25,000,000 a year. Alfalfa for feed is the largest product, but there is a variety of other crops from apples to cotton (see page 655), and in Messilla Valley 4,000 acres of rich bottom lands are affording a highly profitable yield of canteloupes.

The principal water supply is in the Rio Grande, the great floods in which go to waste, but recently work has been begun by the U. S. Reclamation Service on a dam near Engle, to be 265 feet high, to hold the river and create a reservoir 45 miles long to store over 2,000,000 acre feet of water. This water will be largely used in the southern part of the territory, besides furnishing 60,000 acre feet in Mexico. Two other smaller projects in the Pecos Valley will supply water to irrigate rich bottom lands. In 1908 permits were issued for irrigation of 654,500 acres in New Mexico.

In Chaves and Eddy Counties, in the famous Pecos Valley, there is an artesian area with about 700 vigorous wells, some of which yield 200 gallons a minute. The water is nearly all used for irrigation, and some wells irrigate 200 acres or more. The celery at Roswell, which has become celebrated all over the Southwest, is raised in this way.

Dry farming has also been practised to some extent in New Mexico with very satisfactory results when the soil was kept in proper condition, but unfortunately most dry farming is simply taking chances of having sufficient rain to raise a poorly tilled crop.

STOCK

Stock raising has always been a most important source of income in the Southwest, especially sheep, which range in vast flocks through many portions of southern California, Arizona, and New Mexico. In 1908-1909 New Mexico, with about 4,200,000 head of sheep, exported 700,800 head and had a wool clip of 18,000,000 pounds at 16 to 22 cents a pound.

Arizona estimates her sheep at 1,250,000 head. The first sheep, except those in the Navajo herds, were swum across the Colorado River at Needles, in 1876, at the time of the great drought in southern California. It costs about $1 a head a year to keep and feed them, and they pay 100 per cent profit under favorable conditions. The estimate of cattle in Arizona in 1907 was 342,837 head, valued at $3,753,406.

OSTRICH

The production of ostrich feathers has long been an important industry in southern California, and of late Arizona has gone into the business with most gratifying success. The beginning was made in 1885, with an importation of a few birds from California, and the increase has been such that in 1908 nearly 2,000 chicks were hatched. The birds, which now number 2,000, are in Salt River Valley, near Phœnix, where they appear to thrive as well as in their native country.

The birds are plucked every eight months, and the full-grown birds yield a pound of feathers to the plucking, worth about $25. The annual cost of keeping is about $10 a bird. Alfalfa is the principal food. One acre of good stand will support about five full-grown birds. The ostrich needs care when first hatched, but soon becomes very hardy. He matures in four years and is very long-lived. The plucking of the ostrich is done after placing the bird in a small enclosure and covering his head with a hood like a stocking. The picker then raises the wings and carefully clips off the mature feathers. The operation is entirely painless, but care must be taken to remove the dead stumps a couple of months later.

MINERAL RESOURCES

The principal ores of the Southwest are copper, and in the production of this metal Arizona leads the world.

The copper mines of Arizona have had marvelously large production, and while much very rich ore has been mined the deeper workings reveal an almost inexhaustible supply of ore, which will yield good profit unless the price of copper tumbles much below its present low stage. Copper constitutes about 90 per cent of the $42,249,281 aggregate value of mineral products from the territory in 1908.

The largest mines are at Bisbee, Globe, and Morenci, in the eastern part of the territory, and at Jerome, in the central part. There are numerous small mines and new deposits are reported occasionally. The total production for 1908 was 291,584,080 pounds, valued at over $35,000,000. Of this the Bisbee district produced about 40 per cent, the Clifton-Morenci district 27 per cent, Globe 12½ per cent, and Jerome 12½ per cent, approximately. The United Verde mine at Jerome is reported to have paid dividends of $22,270,322 up to 1907. The extent of some of the copper mines is indicated by the fact that in the Copper Queen mine at Bisbee there are 150 miles of rails. Considerable gold is produced in Arizona, amounting to 136,059 ounces in 1908, valued at nearly $3,000,000; silver, 2,571,698 ounces; lead, 2,995,183 pounds, and zinc 2,457,099 pounds.

New Mexico has large mining interests in gold, silver, and copper, there being 134 mines working in 1908, with total output of $1,529,091, of which copper was $806,867, silver $214,673, and gold $298,757.

New Mexico has very extensive deposits of coal. In the year 1908-1909 the coal mines yielded over 3,000,000 tons, having a value of $3,881,508, including

A BRANCH OF MALAGA GRAPES RAISED BY IRRIGATION IN PECOS VALLEY, NEW MEXICO

INTERIOR OF ORANGE PACKING PLANT AT REDLANDS, CALIFORNIA
The oranges are carefully graded and wrapped in tissue paper by machinery

MARENGO AVENUE, PASADENA, ONE OF THE FINEST RESIDENT STREETS, SHADED BY GIANT PEPPER TREES

A ROSE-EMBOWERED HOUSE AT REDLANDS, CALIFORNIA

Photo by W. C. Mendenhall

ORANGE GROVES OF REDLANDS REGION, CALIFORNIA, WITH SAN BERNARDINO MOUNTAINS IN BACKGROUND, ON WHICH SNOW REMAINS UNTIL SUMMER

coke, into which about 12 per cent of the coal is converted.

The U. S. Geological Survey estimates that there are 165,000,000,000 tons of coal available in New Mexico. In the Hopi Indian reservation, in northeastern Arizona, there is an undeveloped coal field of 2,500 square miles containing an enormous tonnage of coal. It is 75 miles from the railroad.

The great oil fields of California are in the southern part of the state, and with rapidly increasing production they promise to be the largest producers in the country. The output in the past year is estimated to have had a value of $43,000,000 or more than the gold production of the state, and nearly 10 per cent of it is produced in Los Angeles.

One well recently sunk near Bakersfield struck oil at about 2,300 feet, and the flow was so powerful that it at once became unmanageable. The oil spouted out at the rate of about 25,000 barrels a day, but fortunately it could be held in a great pool, while powerful pumps have since kept forcing it into a pipe line by which it can be shipped. Up to May 3 it had produced 2,000,000 barrels of oil. The oil sells at 50 to 90 cents a barrel, and is extensively used for fuel, as coal is expensive, and five barrels of oil have approximately the heat value of a ton of coal.

The oil occurs in some unexpected places; one of the extensive fields is at Santa Maria, in the midst of the old mission grounds, while in part of Los Angeles there are hundreds of derricks among the houses, and at Summerville many wells are in the water along the shore.

Excepting its great oil fields, southern California has not been a large producer of minerals. Several gold mines in the desert region have an aggregate output of about $200,000 a year, and this, with various ores, granite, cement plants, and brick yards yield a total of about two million dollars. This is not including the borax, which comes mainly from southern California, with a production of 50,000 tons, valued at about $1,000,000. Formerly, much of this material was transported many miles over the desert by the much-advertised 20-mule team, but now the railroads cross the country, and the energy of the mules is directed into other channels.

POPULATION

The rapid development of southern California in the last twenty years has been phenomenal. It has resulted largely from the disposition of Eastern people to migrate to a region which afforded the climatic advantages favorable to health and agricultural opportunities, especially in the very lucrative business of raising oranges and other fruits.

Los Angeles, the metropolis of the region, has grown rapidly and taken a prominent rank among the cities of this country, with a rate of growth second only to that of Seattle. It is a city of large business interests, and has many thousand comfortable homes, some of them palatial. In 1846 it had a population of only 1,200, in 1880 of 11,183, in 1893 of 75,000, while in 1908 it had increased to 300,000, and this high rate of increase continues. That the city has the characteristic optimism of the West is shown by a recent bond issue of $23,000,000 for a water supply to be brought from Owens River, over 200 miles, with volume enough for a population of 5,000,000.

The population of southern California is mostly American, as is well illustrated in the registry of the last election in Los Angeles, when it was found that out of 33,000 voters 5,000 were born in New York, 4,500 in Ohio, 4,000 in Illinois, 3,000 in Pennsylvania, 2,000 in Iowa, 2,000 in Missouri, and only 5,000 in California. Of the foreigners, who are only in small proportion, Germany furnished 2,000.

The assessed valuation of Los Angeles County is $585,000,000. The city is 22 miles from the nearest harbor of San Pedro, but it transacts a large and rapidly growing foreign and coast trade. More than $1,000,000 has been spent on this harbor, in addition to a $3,000,000 sea wall.

The population of the inland portion of the Southwest is very small, and there are many districts in which there is not one white man to 500 square miles. According to estimates by the governor, Arizona had a population of about 200,000 in 1908, and New Mexico was estimated at 450,000 for the same year. The area of these two territories is about 235,600 square miles. A very large proportion of the population is American born, but many immigrants are now coming in.

Considerably less than half of the New Mexico population is classed as Mexican, and there is a small proportion of persons of Mexican origin in Arizona and California. The principal cities are Phœnix, the capital of Arizona, with a population of about 15,000, and Tucson, Arizona, and Albuquerque and Santa Fé, New Mexico, which are approaching the 10,000 mark.

Pasadena, Riverside, and Redlands are thriving cities, with rapidly increasing population, largely of persons from the East who prefer California, especially in winter. Pasadena is well named "the city of flowers," for it is filled with them. Riverside and Redlands, and a host of smaller places in the orange country, have hundreds of handsome homes, miles of fine avenues lined with splendid trees, and many beautiful environments. All the cities of southern California are growing rapidly, and San Diego, with her excellent natural harbor, has attained a population of 40,000.

PUBLIC LAND

The amount of public land available in the Southwest is greater than in any other portion of equal size in the West. Owing to widespread desert conditions, limited water supply, and rough surface, however, only a moderate proportion is suitable for immediate use.

Nearly all of southern California east of the mountains is open for settlement, but in the fruit region on the coast side all the valley lands have been taken.

Arizona has about 40 million acres of public lands, and New Mexico about the same amount. In the latter territory, in 1906 to 1909, nearly 4 million acres were homesteaded and over one million taken under the desert-land act. Four-fifths of the homesteaders were from other parts of the United States. It is claimed that in New Mexico there are 13 million acres left which are suitable for dry farming and 2 millions capable of irrigation. In Arizona only about 7 per cent of the land has been taken up, and only about 20 per cent of this is under cultivation.

A LAND OF ETERNAL WARRING

By Sir Wilfrid T. Grenfell

Author of "Labrador: The Country and the People," "Vikings of Today," etc.

EARLY descriptions of Labrador are not encouraging, even though its discoverer, the Viking Biarni, son of Heijalf, came from Iceland, and was naturally prejudiced in favor of a country at least more favored than his own. He did the best he could for it, calling it "Wineland," on the principle that Erik had christened Greenland, visibly that "it might draw men thither if the land had a good name."

But Thorwall, the poet of the expedition, has left on record his most unfavorable impressions, which it may be as well to quote:

> People told me when I came
> Hither all would be so fine;
> This good wineland known to fame,
> Rich in fruits and choicest wine,

Now the water pail they send;
To the fountain I must bend,
Nor from out this land divine
Have I quaffed one drop of wine.

and later,

Let our trusty band
Haste to Fatherland,
Let our vessel brave
Plough the angry wave,
While those few who love
Wineland here may rove
Or, with idle toil
Fetid whales may boil.

Many years of Labrador life have left in my mind at least one indelible impression. It was created the first day I set eyes on its rocky coast. It was under a cold, sullen sky, from the icy bosom of the polar current that swathes it, as we caught a glimpse of a low, naked line of headlands and small, barren islands, over some of which the heavy Atlantic swell was making every now and again a clean breach, while here and there great ominous "sea horses" raised their gigantic heads, as they charged furiously over uncharted reefs, which themselves neither gave quarter to nor expected it from anything.

Truly, it is a land of eternal warring. Everywhere along its coast-line great seas ceaselessly pound as with the hammer of Thor into its adamantine sides. The almost resistless arctic ice-flow growls and groans as it crushes, cleaves, and smashes the very face of nature, while the monster bergs outside, like ominous ice giants, roar and crash as they vainly battle with their still more resistless enemy, the summer sun.

Where in the more sheltered spots gentler nature strives to spread a covering over the nakedness of the land, abysmal cold wages battles with the tenacious plants and scrubs, which grow gnarled and knotty in the conflict. The few animals that in any number can survive in its wilds, are especially endowed to resist its apparently never discouraged efforts to destroy the very source of life.

Cradled in its rocky fastnesses, resistless storms sweep madly its already almost denuded bed rocks with a generous abandonment, as if the chance of effecting destruction justified any outlay of energy imaginable. It is a land well suited for the location of the traditional wicked man, as little likely to afford him any dangerous liability to peace.

As one approaches it from the Atlantic and passes its high portals, the cliffs of Belle Isle, the traveler spies a stout log house perched high up on a barren ledge clinging to the very face of the cliff. Suggestive sight: it contains cached the necessities of life against the inevitable day when some poor voyagers shall find themselves suddenly dependent on its savage clemency. Meanwhile, the thoughts of those who know fly to the poor creatures from the "Dainty Lady," the liner *Scotsman,* which, laden with Christmas cheer, late one fall received the hospitality of its eastern ledges, and now lies a scrap heap in her deep-water graves close by. One sees, meanwhile, visions of women dying in their tracks as they painfully struggle toward the western end for shelter. Sometimes one seems in its storms almost to hear their screams of joy over just such victories.

Viewed, as those who frequent it mostly view it, from the sea, one would think its sole harvest was the countless ice-borne erratics that crowd every hillside and crown every sky-line, just where other countries would be flaunting flowers, fruits, and trees.

Still there remains in my memory, after all this lapse of years, the intense curiosity I then felt to learn what kind of human beings such an environment had evolved. Since then I have learned that in the realms of human life also the same stern conditions maintain. Life is truly a battle in Labrador, and its conditions are responsible for a white race as remarkable for their adaptability to live under the very hardest of physical conditions as the native Eskimo they are steadily replacing. These little arctic natives can withstand anything except civilized man.

But Labrador, beyond being a place of war, is a land of contrasts—a land where extremes meet—and where no man dieth

HAULING UP AN OLD HARP SEAL IN WINTER ON THE WHARF

We eat these and feed dogs on them, and sell the skin and fat

from monotony of physical circumstances. Scarcely a stone's throw from this ceaseless strife one finds oneself in a land almost of oppressive silence—a country so utterly devoid of the busy hum of human life that the dominant idea forced upon one is, "Can I be certain I shall ever again get back to the haunts of men?" while visions of the uncertain opportunities for communication with the world outside rise unbidden to the mind.

Soon, however, memories of its generous spaces, its glorious fiords, its keen, bracing air, its call for resourcefulness, its rich sea harvest, its noble rivers and plenteous salmon, its wily, silent animals with their priceless skins, its countless deer herds come back to cheer one. Its splendid evergreens, its gorgeous mosses, the carpet bedding of its brilliant lichens all serve to relieve the first chill of its barrenness. Add to these its beauteous nights, its long twilights, the fantastic

A BREAKING SEA ON THE ROCKS

HEBRON, LABRADOR, SHOWING MORAVIAN STATION
This mission from Moravia was founded by Zinzendorf in 1770. It has six stations

INDIAN HARBOR—OUR HOSPITAL,—A LABRADOR FLEET HARBORING—MOUTH OF HAMILTON INLET

Peary's first place of call from the north, and the most northern wireless station

colors of the moon shining on its weird ice and deep blue seas, the unearthly loveliness of its auroras, and the magnificent tracery of its northern cliffs. Such a land is it of changes and of contrasts that those who love it at least may be forgiven for thinking it the borders of fairyland.

It is indeed a fine set of people it has produced, for we count as Labradorians the thousands of men and women from Newfoundland who every year come to wrest a living from its reluctant grasp.

I was watching one day from our decks a fleet of what seemed such tiny schooners to be battling with the circumstances of Labrador, as to suggest foolhardiness on the part of those who handled them or indifference, except to gain, on the part of those who owned them. A number of boats had come alongside, bringing patients or visitors from most of them. Some comment made as to their size was half heard by a woman from one of the schooners, and she turned and told me about it.

Apparently it was "her venture." Her husband and three sons had been forced to fish home, "having no boat large enough to carry them to the Larbardore." She had stimulated them to put their all into this small 20-ton vessel. They had been unable to pay a crew, so she not only let all her boys go, but went herself, and to fill up the complement persuaded her eldest boy's young wife to join them also. No wonder the vessel loomed up large in her eyes, for now all the earnings of the "ship" would be kept in the family.

Sea love, self-reliance, and optimism are the three strongest traits of character developed in our people, with rather more than the ordinary amount of fatalism.

There is no doubt the people are tough—tough as their own sharks, they say, which will come to a bait made of their own liver, or continue to eat after being disemboweled. Anyhow, the latter are so unemotional, that I have gaffed three with a boat-hook prodded into their heads as they swam on the surface in the same pool, and then hauled them out to freeze ignominiously on the floating ice.

I have lain shivering in my bag on the floor of a house, when the youngsters have been curled up in a heap with "ne'er a covering," and snoring enough to shake the rafters. (A great many suffer with adenoids.) I have tried to allure them to drink cocoa and milk on a cold morning, and seen them pour it surreptitiously outside the door as being "too full o' sweetness," and heard a man say and mean it, "you give me a lassie duff in the morning and that'll last me all the day."

I have seen our postman start off in winter on his fifty-mile tramp with nothing but a piece of dry, hard bread in his pocket, and this he has been doing these past forty years.

I have known a woman (with now ten children) put off laying up for her confinement till she had to run from the wash-tub, leaving her husband's overalls unwrung, and be up and wring them herself three days later. She was at the time living on dry flour, and not once a week getting enough of that. She had no bed clothes at all, and she told me her leaky house has prevented her turning over in bed because her dress was frozen to the wall. Herself and children are now my flourishing neighbors. She never had a day's real illness till ten days ago, when she came into the hospital and had her appendix removed.

In my mind there is no doubt, however, that Labrador can maintain a good population, but at present no capital has been invested there except in the fishery and furring. Neither of these industries do practically anything to enrich the country, seeing that almost every fish caught and every fur killed leaves the coast as it is, and is turned into money elsewhere.

Cod, salmon, and trout are exploited rather than fished. Rivers have been barred with nets for years. The indiscriminate use of cod traps with small mesh leaders destroy every year thousands of salmon-peal seeking the rivers, and, in the opinion of every one, injure

LABRADOR FISHING SCHOONER, BLOWN UP HIGH AND DRY AFTER A BIG GALE

These storms are rare in Labrador; a really bad gale doing damage of any extent to craft is quite infrequent

very seriously the cod fishery itself by almost entirely preventing the great shoals coming inshore to feed. No means are taken to recuperate this fishery. There exists no fish hatchery, and no scientific use of deep-sea thermometers. Only a very few use preserved bait, and there is no bait-freezer on the coast, and no cold storage to carry away fish fresh to market.

As yet the putting up of fresh codfish in tins has not been successful in the markets because not backed by capital and advertisement. We used the past winter side by side the fresh fish frozen and some excellent tinned cod put up by an enterprising firm from Fogo, Newfoundland, and as yet at least no one has been able to tell which fish they were eating. What has happened to our mackerel and our marvelous herring I do not know; all I am able to state, no scientific efforts have been made to find out.

The survey of the coast is so ancient and so unreliable that we have devoted considerable time to making charts of our own, in which efforts I have during two summers been helped by his excellency Sir William MacGregor, the former Governor of Newfoundland.

Till quite recently not a single lighthouse served to help the numberless craft plying their calling on the coast, and still today not a single harbor has a light or has in any way been artificially improved.

I remember well when the only light

MY LEADING ESKIMO DOG, "CÆSAR": BATTLE HARBOR, LABRADOR

on the coast was from the north window of a tiny building put up by pious hands for religious services in summer. In this two large kerosene lamps used to be swung round to face the north windows every dark night in the fall of the year, to be a literal guide to the poor schooners trying to make a safe anchorage on a very dangerous part of the coast. Once because this light was out I had to steam to my anchors for 24 hours to save the ship, while all of seven schooners anchored near were driven on the rocks.

For our own consumption we still get plenty of herring, and they are the largest, fattest, and sweetest in the world. As an old resident of Yarmouth, England, one should know something about herring as an article of diet.

Practically no use is made of the billions of capelin that can be bailed out of the sea with a dip net. That they could be preserved profitably there is no question.

The other sea denizens of value that are exploited at present are whales and seals. The former are not in any great abundance, and the factories do not return more than the outlay that such a speculative business calls for. The hump is the commonest of our whales, a smaller animal than the rest, and not nearly so valuable as the larger sulphur-bottom, or the occasional sperm that strays into our waters.

From 50 to 100 whales is a paying season, and as with the hogs at Chicago there is very little wasted, even the

LABRADOR SCHOONERS IN MAY IN SAINT JOHN'S HARBOR

They come there to get their outfit of flour, molasses, pork, tea, and salt for curing fish. These "pans" of ice are called "Growlers," and are the remnants of the Arctic floe

A WEIRD PIECE OF ICE IN BATTLE HARBOR

blood being collected and turned into fertilizer with the bones. The products of the ductless glands, which as the creature is a mammal should be really valuable, have never yet been extracted. The University of Kansas, through its enterprising industrial chemistry department, is anticipating work on these from the pineal gland to the suprarenal capsule next year.

Whales seem to depend for safety more on their ears than anything, their eyes being of little value. Indeed the eye with all our animals except birds is least relied on. A fox will jump into the arms of a man on an open marsh if he keep still and is down wind. A stag will run right up to a man, who stands without moving in the lead it is traveling. I have seen a stag charge down on a man with a head and horns of a lately killed deer placed over his head and shoulders, the stag not noticing he had only two legs.

But birds are the reverse. Ear and nose count for nothing compared with the eye of our hawks, gulls, and even less wary birds. Ducks do fail more signally to tell things that are dangerous by sight, but it seems to be obtuseness in the process of their cerebration and not keenness in recognizing. Like many men they don't act quickly enough.

A strange mistake in instinct our migrating ducks always make when it is foggy. They never seem to escape it. They come south along the coast for full 600 miles, flying close to the headlands. When they have gone 580 miles they pass Cape St. Lewis, and a wide, deep bay opens up with only the narrow south side of the bay between them, and the Straits up which nearly all the ducks are bound. As sure as ever a northeast wind blows, and there is too much fog to see across the inlet, practically every single flock will turn up the bay evidently mistaking it for the Straits. They are unwilling to rise and cross the land, I presume for fear of losing their bearings, so they follow the shore right

THE SUMMER HOUSE OF A FISHERMAN IN LABRADOR MADE OF TURF AND SODS

These houses are abandoned to their fate and allowed to fill with snow and ice; the people just clear this out and use it again next year. It gets welded together. White shells are used on the floor. These particular men own no schooner of their own to fish from, so take passage on a friend's and fish in small boats from the land.

SMALL SCHOONER PUSHING "DOWN NORTH"

The iceberg and the floe-ice show the dangers and the fearlessness of the men. These vessels are only 2½-inch planking, and every year some are sunk by the ice going through their sides. It is remarkable how few lives are lost, however. The pieces free are used as rafts till another vessel comes to the rescue.

around, passing between some islands and the southern cape.

So regularly is this the case that every northeast wind in the fall, without exception, a crowd of gunners line this tickle or strip of water between island and mainland, fire at random into the passing birds, and share equally the victims that fall. It is worth any one's while to join this company once, if only to see the arquebusses and almost "culverins" that some of these men produce and fire out of.

Their dogs, too, are a wonderful sight retrieving in these breaking seas, and climbing back against the back wash up these smooth-worn cliff sides. Only native dogs can stand it. My English retriever and spaniels are forced to confine their attention to the little piles of birds that soon grow up behind each sportsman, which with skill worthy of a better cause they steal and bring to mine.

For home consumption, however, the seals are most valuable, their skins and fat forming a marketable commodity of no mean value. When seals "strike in" plentifully it is the easiest way in the world to get rich, for it means that this source of wealth just comes to your door and drown themselves in your nets ready for your use.

Certain headlands are far better than others for this purpose. These are situated generally close to great turns in the land, as if the seals under water steered by the coast exactly as the birds do above. The analogy is made closer by the stupid way so many trim into one or two wide blind bights near the corner,

HEAD OF A WHALE, SHOWING THE BIG BARNACLES THAT GROW ON THESE CREATURES, AND ALSO RELATIVE SIZE OF A MAN AND A WHALE'S JAWS

exactly as if they had lost their way, a good instance being L'Anse Amour Bay, behind Forteau light-house.

The other great way to catch seals is known as ice hunting, and means following the whelping herds out on to the drifting floe ice, which is done either in large vessels or with light punts hauled over the floe from the neighboring land, or simply by venturing out on a run and chancing getting back to land again.

Labrador seals are real seals, and not the fur-bearing "*Otaridæ*" of the Pacific. Our largest, the hoods, are of immense size and height, and by no means to be carelessly approached when with their young. They will then show fight very readily, and many a poor old bull has come by his death from a rifle just to enable the murderer to steal the pelt of his baby that he was defending, his own body being left, after all, as being too heavy to take.

Their strength is well shown by there being found in their stomachs shells that do not exist less than 90 fathoms down, at which depth they must withstand a pressure of eleven atmospheres, while puny man, with all his apparatus, has not been able to descend thirty fathoms. Specially provided for spring boot bottoms are the *Phocæ barbatæ,* or square flippers, their skin being very thick and water-tight, and almost hairless. Of any and all these the meat can be eaten, and the fat used for fire and light.

That a young seal can rival the fatted calf on his own ground is shown by the fact that a white coat, or Kotik, of 38 inches long will have an immodest waist of 34 inches round.

Excellent as their skins are always for sleeping bags, canoes, tents, harnesses, etc., for clothing, in cold weather they cannot touch the cured caribou hide. In mild weather the seal hides are, as might be expected, much more water-tight, except when tanned, which we do by letting the skin "tint" till the hairs can be scraped off, and then soaking them in the boiled bark of our fir trees.

The soft chamois-like, cleaned skin of the deer makes clothing impenetrable to wind and weather, while the gloves and moccasins, being soft and mobile, are far warmer than the Labrador seal. So important a point in keeping warm is this mobility of the boot that in really cold weather there is a perceptible difference between a doe-skin moccasin and one made of an old stag, the thinner doe-skin being much warmer.

These deer are in great abundance still, and are still a staple article of diet and clothing, and even tent covers, with all our northern folk. The softened skin is generally brought out by our Indians and sold by the pound. They also bring out what they call parchment—that is, skin with the fat left in and the hair removed. This is used for filling snow-shoes, and is often sold by them cut all ready into "babbage," and rolled up into balls like string. The winter skins of deer killed by Eskimo are invariably used as bed spreads, the close, thick hair forming the best insulator possible from the cold ground.

When old or superabundant, these are exported to Germany, where with true Teutonic economy they are used for station mats till the hair is all trodden off, after which they become white buckskin gloves for the immaculate guards of the German Emperor.

That these deer can obtain in such quantities in spite of their numberless enemies, human and otherwise, proves what an immense industry is possible in raising domestic reindeer for their meat and hides. I have just heard from a doctor friend in Alaska, whose herd of 70 in 1902 has become 490 in 1909. My own herd of 250 in 1907 has become nearly 600 in 1909.

Flies are, strangely enough, really the worst enemies of the deer. There may not appear a single fly mark on a deer one kills, and yet among many hundreds of skins I never yet saw one skin that has not from 100 to 1,000 holes in it bored by the grub of the hornet-like fly we call "stout," while it is safe to bet that you can never kill a caribou without finding eggs, chrysallides, or the maggots of these flies lying among the ethmoid cells,

The sealing industry is carried on in March and April, when the Arctic ice comes south in vast fields. On this the Harp and Hood seals whelp. The big steamers, 22 in number, force their way through it, collecting and killing the helpless young. This is the ship's crew hauling sealskins with fat on to their ship.

A SEALING CREW "PANNING SEALS"

In this case the seal pelts are all massed together. Flags denoting to what ship they belong are fixed up on the heap, and the ship endeavors to pick up all her "pans" as opportunity offers. Often she never finds them, and so much waste occurs many times; also another crew comes along, removes the flags and annexes the seals.

or soft bones, far up in the nose and right against the base of the skull.

Wolves in Labrador are not very plentiful, judging from the quantity of skins sold annually at the various fur-trading posts, but they are naturally the relentless foe of the reindeer, whom they always follow till they kill. Of all the tragedies of life that appeal to me as pathetic in Labrador, none equals the wearing down of a gentle deer by these grim shadows of death. To know, as they must, that a wolf is on their track, and that there is no defense against him, no safety night or day, must be a prolonged nightmare besides which the pain of being torn to pieces alive by a hawk or eagle is an easy death.

A deer at bay, standing on his hind legs, makes an excellent fight with his enemy. Not only have trappers told me of scenes of this kind they have themselves witnessed, but I saw my own largest Eskimo dog twice knocked head over heels by one of our own tethered reindeer stags that the brute was endeavoring to kill.

Black wolves, or nearly black ones, are occasionally killed on our coast. I know of no one who ever saw a white one on our coast except the author of "Northern Trails." Among other animals of value, the black and silver fox rank easily first.

No fur can be said to have a standard value; the range is immense. Five years ago, on the coast, Patch foxes fetched as high as $30.00 apiece, and the best lynx skin only $3.50. Today the Patches are worth $8.00 to $10.00 at very best, while the lynx are worth $25.00 to $30.00. I have bought sables on the coast at $3.00, and a year or so later at $30.00. Today they are down again to about $10.00. The biggest range is naturally in black and silver foxes, which I have known fetch once on the coast $900.00. On the

ESKIMO GIRLS OF OKKAK, LABRADOR

CHARTING OF LABRADOR

Governor Sir Wm. MacGregor at the theodolite; Mr Gould, of Bowdoin University, acting secretary. This is some of our volunteer work

other hand, I have known a trapper paid $40.00 in trade (value about $20.00) for a fox which fetched $700.00, or £140, in the market.

I have tried breeding foxes for five years, but without success. My "parks" were close to the houses, and too much disturbed, I presume. But others have had good success, and I intend later to try again further in the country.

That black parents throw black pups is a fairly well-established fact, especially when the black parents are of the second generation. That black pups are sports of red parents, just as bitches have puppies of many hues, is also true. It is possible naturally for these black scions of red parents to throw back and have red pups. But with black grandfathers and mothers, the puppies are pretty certain to be black also. The feeding of these is no more difficult than that of any ordinary dog, and the offspring may be worth $1,000 apiece. Last year I saw dug out from an island four small foxes, all dark silvers. These had a black mother, but unfortunately the dog was not seen. I presume he also was dark.

Other writers to the contrary, foxes of the same brood will kill and eat each other. I have known it three or four times.

Of bears generally I have little to say. We have our share of black and white. Both of these I have shot and eaten. The flesh of both is good and nourishing. The black bear, being a herbivore, as a rule tastes much like venison. He is, however, exceedingly fond of fish, and he not only poaches salmon pools, but comes to his death from this predilection, for it leads him to wander in search of the innumerable dead capelin, and to venture almost into the summer fishing settlements.

Many interesting tales about bears nat-

THE PHYSICIAN'S DOG TEAM AWAITING HIS RETURN FROM A WAYSIDE CONSULTATION

DR SEYMOUR ARMSTRONG GOING ON A SICK CALL: LABRADOR

SENDING SOUTH FISHERMEN WHO HAVE DIED AT HOSPITAL

It is the custom to preserve the bodies in salt—when their own schooners call for them and carry them to their southern homes

urally exist on the coast. In the space at my command only one or two things, however, are worth noting. There can be little question that the polar bears, together with other animals, like caribou, and seals, and birds, possess a sense not inherent with men, viz: a direction sense. Whether it is magnetic or what, I do not know, but I am convinced it exists.

I have followed bear tracks for many miles, both along the coast and inland, and whether the course took him over flat snow fields, large lakes, through dense woods, or across wide arms of the sea, he always kept going steadily north. I refer now to stray bears that have followed the whelping seals too far south on the ice fields.

I met a polar bear once in the open Atlantic full three miles from the nearest land, just rolling lazily along north. If there were anything to be said for the evolutionary influences of natural selection, the polar bear should certainly be as amphibious as the seal in the near future.

But I must leave the animal resources of Labrador, and come to the vegetable wealth—a source of wealth that is by no means to be despised, as it is very easy to show. The red partridge berry or small cranberry, the blue hertz or bilberry, the yellow bake-apple or cloud-berry, the purple marsh-berry, with the red currant, the raspberry, and gooseberry, are all abundant, all easily preserved, and all grow without any effort on the part of the natives to sow, cultivate, or in any way improve them.

Sweep up a barrel full of the cranber-

THE FEW SHEEP HAVE TO BE SO CAREFULLY TENDED THAT THEY GET QUITE TAME

ries, and let them stand exactly as they are in a barrel, and they will be good all winter. Fill a barrel with the luscious bake-apples, pour in water and head up the barrel, and you have a delicious fruit all winter.

Nature, moreover, looks after you if you are too lazy to do this, and your children can run out in spring and pick cranberries and marsh-berries that have only sweetened for being under the snow all winter. The red of the cranberry is also a natural dye.

Of cultivated vegetables in Labrador the success depends on the shelter, natural or artificial, they get from summer frosts. In the bottoms of bays, carrots, peas, potatoes, lettuce, radishes, beets, etc., all grow in the open well.

Lord Strathcona developed a potato whose leaves crept on the ground instead of standing upright, and thus escaped these summer frosts. The Moravians gain the same end by covering the beds with rolls of brin or burlap, putting their potatoes to bed when they go themselves.

The leaves of our spruces make an excellent brew, when boiled with molasses and fermented, though the result is too intoxicating for an enemy of alcoholic beverages like myself.

There is no need whatever for the scurvy that so generally afflicts some of the families every spring, except their own carelessness and ignorance. Now we seldom, if ever, see it. Mushrooms, of the varieties Russulæ and Boleti, grow in great abundance. Those who know, eat them freely fresh in summer, and, threading them on cotton strings with a needle, suspend them in the house and let them dry for winter. They swell out, and taste as good as fresh.

This is a commercial rather than an æsthetic article, and sooner than describe our innumerable flora of the small but bright sub-arctic varieties, whose abundance is well attested to by the fact that we have no less than 14 varieties of *Potentilla*, I will say a word about other possible industries for the country, though while speaking of flowers I should mention that the coveted Alpine Edelweiss has been introduced near Hopedale, and can now be found growing wild in the neighborhood. The immense future that lies before pulping in this country is, I think, very evident from the success attending Lord Northcliffe's great venture in Newfoundland, and by the fact that every acre of sea and land from the Straits to Hudson Bay has been applied for ahead, if not granted, for this very purpose.

The incalculable energy of the countless falls, including the Grand Falls of the Hamilton River, probably the third largest in the world, and second only to the Victoria Falls in height, is an asset which the future will be unable to overestimate. Now that chemistry stands on the very verge of a synthesis of atoms, and a new world seems to lie at our feet if sufficient energy is procurable, these hitherto unappreciated riches are beginning to excite attention. I have had already inquiries as to the feasibility of bridling these falls for the purpose of collecting nitrogen from the air for fer-

PACKING WITH DEER IN SUMMER: LABRADOR

SOME OF OUR REINDEER

A BATCH OF MY LABRADOR ORPHANS

Open-air treatment for orphans

tilizing purposes. It is well known that the world supply of nitrates is giving out; that wood as fuel, and even coal are rapidly diminishing. Here lies one immense source of wealth that even the dull eye of a twentieth century scientist can foresee.

In our vast bogs lie supplies of peat that are almost inexhaustible; only these last few years has industrial chemistry turned its attention to these natural resources. All round this country the little settlements are bare and denuded of the beautiful evergreen trees given for their protection and for preserving animal life, just because of the ignorance of the heating material lying in the unused bogs, which instead of being injured would be improved by being used as a fuel supply.

The vast area of ledges, which run along our east coast, produces in places immense quantities of various seaweeds, which the storms pull up and fling at our doors without our having to stir a finger. In Norway the ashes of these weeds, just burnt on the beach, fetch from $2.25 to $3.75 a pound, and bring to the country as worked now $150,000 a year. Nature seems to make special provision for primeval-minded man, which as he increases in numbers is withdrawn, and so he is forced to put his wits to work and grow in stature whether he likes it or not.

In the spring, berries for us are ready under the snow, shell-fish in abundance under the harbor ice. Soon flat fish and round fish are veritably thrown on the beach, and can be dipped out with a hand net and can be speared with a straightened hook on a stick, or, as old Cartwright tells us, are at times so plentiful he could lie on the rocks and catch them by the tail in his hand. Trout we

"The man in the middle crossed the Straits of Belle Isle alone last winter, making three trips to and fro. He dragged a boat he built of canvas and laths, 7 feet 6 inches long, 2 feet 3 inches wide, and 13 inches deep. He had a little canvas cover, an oil stove, some food, and nearly 200 pounds of mails. He was out all one night in one of the worst gales we had, and drifted next day to land with his boat almost to pieces. He covered the bad parts of the laths with tin and went cheerfully on. He is a Labrador native, and his name is Ernest Doane."

can get in abundance through the ice all winter. Salmon and trout come walking into a net, only a few yards long, tied to your own wharf head.

Hares—well, I shot four in a couple of hours yesterday behind my house in this now growing settlement. Partridges—*i. e.,* willow grouse—well, my larder is stocked with them hanging from hooks that were shot last fall. I have known an Eskimo to kill 500 of these partridges by the simple process of flicking off their heads with his dog whip. Meanwhile there is another equally guileless and dainty variety, called spruce grouse, who sit on a bough while you go and slip a noose over their head, not requiring even the expense of ammunition.

I have not room here to write more of the native races that the white population are now displacing. Like all ignorant people of all races they are the cause of their own undoing. The indiscriminate cohabitation, and even marrying, is one serious factor in their downfall. Here are two cousins, each of which marries the other's daughter, so that each became the other's mother-in-law, sister-in-law, and cousin; and here, again, is another, who married his own son-in-law's daughter, so that she became, I presume, her own step-grandmother and her own father's mother-in-law.

Their lack of interest in sanitation or any health laws, and contempt for any prophylactic precautions, is simply phenomenal. I have taken away the clothing of a patient with typhoid and a high temperature to keep him in bed, and found him outside the house next day naked, while their passion for "something to rub" or "something that will

stick on"—*i. e.*, a plaster—would make the calling of a medical man impossible on this coast if seal and bear oil was not as acceptable to them as olive, if oakum and moss did not serve as well as padding for dressings, and if coniferous resins were not adhesive. Plain board beds seem to give rise to no bed-sores through their thick acclimatized skins.

An antipathy to anæsthetics would have rendered more than one operation impossible had it not been for their stoicism and inordinate pride in being the center of attraction, which, as a superior mental emotion, led one young woman to grin while I amputated her frost-bitten toe, just because the tent was filled with an admiring audience. It has always struck me that they would be good material for Christian science.

With dog stories and winter travels the coast just abounds, and many a night by a log fire I have listened to the most exciting yarns of old hunters. But here there is no room for these. Suffice it to say, I have tried most sports that young manhood in civilization affects, and I have yet to find a match for our winter traveling.

There are lots of poor, yes very poor, people in Labrador. I have seen nakedness and starvation every year that I have been here. That is why we are here, not merely because these are miserable people, but because those people we believe need not be miserable or starving or naked. It is true a man's work must in spite of him crystallize often enough into temporizing methods. It is the same in our professional and every other work at times.

But we believe in the country, and we believe in the people. The former can, we are convinced, evolve a worthy contribution to the human race—a people not enervated and enfeebled by the soft things of life or by artificial conditions. We hope to be factors in hastening the process.

It has been suggested to change the whole climate of Quebec by damming the Straits of Belle Isle and shouldering off the arctic current. Nothing is impossible. The north side of the Straits is an admirable spot at present for a penal settlement, and material is not lacking with which to fill up that shallow strip of water. A railway can be run with ease to the bottom of St. Lewis' Bay, and bring in its train increasing comforts and increasing facilities for living. But without these we have been privileged ahead to see the dawn of a better day, and we only stand grateful to Labrador for the opportunities it has afforded us.

NOTES ON THE DESERTS OF THE UNITED STATES AND MEXICO

Some desert plants have cisterns which they fill with water against the days of drought, just as the ant stores its cellar with grain and choice morsels in preparation for the days when it is imprisoned by the rain and snows of winter. Another species will spend many years to gather the force to send upward a single stalk of flowers and then immediately die as if contented, after years of labor, to perpetuate itself by this single blossoming. Other plants have developed hairy coverings and resinous coatings which protect them from the burning sun's rays and also prevent the evaporation of the water they have secreted. These and other wonderful characteristics of desert vegetation which have long excited the wonder and attention of botanists are now being systematically studied in the desert itself by the plant specialists of the Desert Laboratory, at Tucson, of the Department of Botanical Research of the Carnegie Institution of Washington. It is believed that these researches will result in much new information as to the origin and physiology of plants, and that they will also ultimately be of much practical assistance to the agricultural interests in sections where the rainfall is slight. The following article has been abstracted by the Editor from a recent publication by the Director of the Department of Botanical Research, Dr Daniel T. MacDougal, "Botanical Features of the North American Deserts." The illustrations are from this publication and are from photographs by Dr MacDougal.

TUCSON has a climate of a thoroughly desert character, and a flora, including mountains and plain, rich in species and genera. In addition to its situation in the heart of the desert of Arizona, it is centrally located, both as to position and transportation, with reference to the deserts of Texas, Chihuahua, New Mexico, California, and Sonora. The city has a population of nearly 22,000. It is situated on one transcontinental railway, and has good connections with others, as well as shorter lines to various regions of interest.

The business of the city and the conduct of its municipal affairs are largely in the hands of progressive Americans. The elevation of Tucson is 2,390 feet, while the highest of the mountains that surround the plain in which the city lies, the Santa Catalina Range, reaches about 7,000 feet higher. The University of Arizona, with its School of Mines, and the Arizona Agricultural Experiment Station are located at Tucson.

Not the least of the advantages of Tucson as a center for the activities of the laboratory is the broadminded comprehension of the importance of the purposes of the institution evinced by the citizens, accompanied by an earnest desire to coöperate in its establishment. This appreciation was expressed in the practical form of subsidies of land for the site of the building and to serve as a preserve for desert vegetation, the installation and construction of telephone, light, and power connections, and of a road to the site of the laboratory, about two miles from Tucson. The monetary value of these concessions is by no means small, and is much enhanced by the generous spirit in which they were tendered. This spirit of hearty coöperation has animated every organization in the city, and has enabled the laboratory to gain control of a domain of 860 acres, of the greatest usefulness for general experimental work.

IN THE "JOURNEY OF DEATH"

Extending northward for nearly 100 miles from El Paso is the noted Jornada del Muerto (Journey of Death), which has a width of 30 to 40 miles. It formed

COLUMN IN THE WHITE SANDS OF NEW MEXICO

The shade and mechanical action of the roots of the three-leaved sumac have prevented a section of a dune from being moved by action of the sun and wind, and it remains in columnar form (see page 693)

a portion of the route connecting the earliest settlements along the Rio Grande, and here the traveler was compelled to leave the stream far to the westward, in its deeply cut, inaccessible canyon, and toil for two or three days in the burning heat without water, except such as might be carried. It was for three centuries one of the most menacing and hazardous overland journeys to be encountered in the American Desert. Recent investigations, however, have shown that the region traversed is in reality a basin, and that water is to be found, as in many other deserts, within a reasonable distance of the surface.

Beyond lies an equally remarkable desert, the Otero basin, which is the bed of an ancient lake, and is noted for a great salt and soda flat, a salt lake, and, most striking of all, the "White Sands," an area of about 300 square miles covered with dunes of gypsum sand rising to a maximum height of 60 feet.

The surface of the dunes is sparkling white, due to the dry condition of the gypsum powder, but a few inches beneath it is of a yellowish or buff color and is distinctly moist and cool to the touch, even when the air is extremely hot. The smallest particles may be crumbled in the fingers, and as a consequence the dunes are solidly packed.

The most characteristic plant of the dunes is the three-leaf sumac (*Rhus trilobata*), which occurs in the form of single hemispherical bushes 4 to 8 feet high, the lower branches hugging the sand. The plant grows vigorously, the trunk at or beneath the surface often reaching a diameter of 3 inches. The binding and protecting effect of this bush is often shown in a striking manner when in the cutting down of an older dune by the wind a column of sand may be left protected above from the sun by the close covering of the branches and leaves, and the sand in the column itself bound together by the long penetrating roots. One of these columns was about 15 feet high from its base to the summit of the protecting bush and about 8 feet in diameter at the base (see page 692).

A curious fact brought out in the exposure of the underground trunks of this plant by the shifting of the dunes is the abundant exudation of a pale amber gum with the characteristic aroma of the crushed twigs. This, mixing with the sand, forms hard, honeycombed masses sometimes 3 inches in diameter.

A marked peculiarity of the White Sands is that a cottonwood is occasionally found in the lower dunes, reaching a foot in diameter, but seldom more than 15 feet in height; yet at the same time not a mesquite was seen. The mesquite is a tree requiring less moisture than the cottonwood. Apparently the presence of an excess of gypsum is prejudicial to the growth of the mesquite.

The bottoms among the dunes have a dense vegetation as compared with that of the dunes themselves. It is characterized especially by the presence of a grama grass (*Bouteloua*), forming almost a turf, and by frequent clumps of *Ephedra* of a grayish purple color at this season and with 3-scaled nodes. These bottoms usually show no sign of moisture, but in two places we found waterholes, the water so alkaline that the horses would not drink it at the end of their first day's drive.

The relation of *Yucca radiosa* to the sand dunes is unusually interesting. A group of four small yucca shoots standing about 3 feet high to the tip of the highest leaf was found upon the summit ridge of a 30-foot dune. We dug the trunk out to a depth of 14 feet. All four plants were from branches of the same trunk, the lowest branch arising about 16 feet from the base of the dune; the main trunk and the branches bore marks of rosettes of leaves at intervals all the way to the lowest point reached. The trunk sloped in the direction in which the dune was moving. The yucca originally grew on the plain, was engulfed by the sand, and gradually grew through each successive layer of sand that drifted over it until the summit of the dune was reached. In the vicinity, at the rear of the dune, were other long trunks partly denuded by the passing of the dune.

THE PLANT THAT OWNS A CISTERN

Probably the most extraordinary product of the Sonora Desert, west of Torres, Mexico, is the guarequi (*Ibervillea sonoræ*), a tendril-bearing plant whose inordinately thickened root and stem base lies gray and half exposed upon the ground beneath some trellising shrub (see page 696). These tuberous formations may be seen during the dry season lying about wholly unanchored, as the slender roots dry up with the close of the vegetative season, which lasts but a few weeks.

In February, 1902, some of these tubers were taken to the New York Botanical Garden, and a large specimen not treated in any way was placed in a museum case, where it has since remained. Annually, at a time fairly coincident with the natural vegetative season in its native habitat, the major vegetative points awaken and send up a few thin shoots which reach a length of about 2 feet only, since they do not obtain sunlight. After a period of a few weeks, they die down again and the material in them retreats to the tuber to await another season. Seven periods of activity have thus been displayed by this specimen with no apparent change in its structure or size. It does not seem unreasonable to suppose, therefore, that the guarequi is a storage structure of such great efficiency that water and other material sufficient to meet the needs of the plant for a quarter of a century are held in reserve in its reservoirs.

The guarequi is reputed locally to be very poisonous, but repeated tests by Dr William J. Gies and Miss Julia Emerson, with living material, hot and cold water extracts, and alcoholic extracts, fail to produce any results with the various animals used as test objects. It is quite possible, however, that the living vines or the fruits might yield substances upon which the prevailing opinion is based.

The morning-glory (*Ipomœa arborescens*) is here a tree 20 to 30 feet high, with smooth chalky gray trunk and branches. During February it is leafless throughout, while its large white flowers open one by one on the ends of the naked branches. From its white bark the tree is sometimes known as palo blanco, and from the gum or resin, which exudes from incisions made in it for the purpose and which is used as incense in religious ceremonies, it is called also palo santo.

WONDERFUL CACTI THAT STORE HUNDREDS OF GALLONS OF WATER

One of the striking features of the Tehuacan Desert of southern Mexico is the extreme localization, or strictness of colonization, exhibited by many species which are found to cover an area of a few square yards, the face of a slope, the crest of a cliff, or the floor of a barranca, with no outliers and with the nearest colony perhaps many miles away.

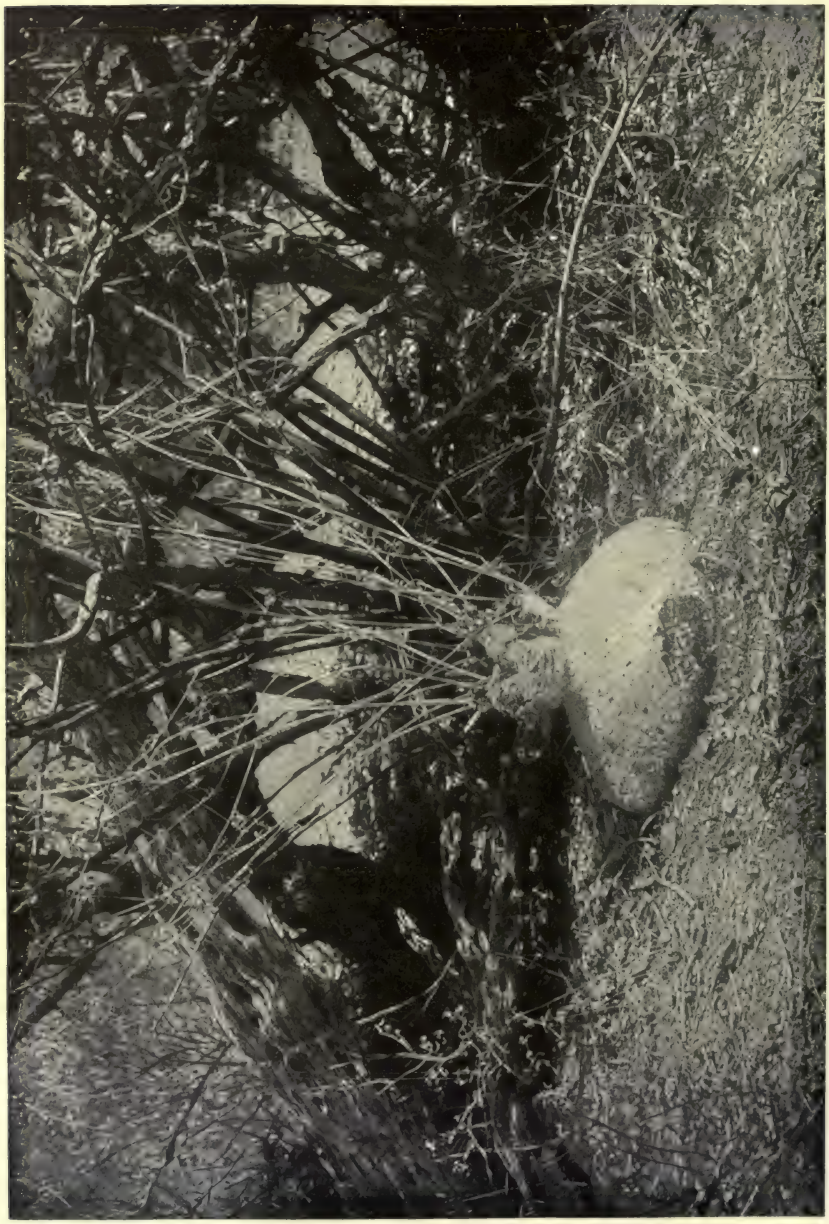
The Cactaceæ are more abundant here than in any other part of the world yet visited, several of the species being massive forms, which constitute very prominent features of the landscape.

Cephalocereus macrocephalus (see page 698) is a tall species of the massiveness of the saguaro, and like it having a central shaft bearing numbers of branches which are more closely appressed. It was seen only along the cliff near the Rancho San Diego, along the eastern edge of the valley. *Pilocereus fulviceps* (see page 699), of more general distribution on slopes, has a series of branches, in many instances 40 or 50 in number, densely clustered and arising from a short trunk, which barely rises from the ground before it branches.

Echinocactus was represented by a half dozen species, of which one, *E. grande* (see page 701), is undoubtedly the most massive of all the genus, being as much as 8 or 9 feet in height and 30, or even 36, inches in thickness, which, with the many convolutions of its surface, makes it a very grotesque feature of the scenery. The young of this species are characterized by very striking cross-stripes which disappear with age. Upon testing the pith to compare the watery content with the northern species, it was found that so much calcium had been taken up and stored in the form of calcium oxalate or

Yucca radiosa

Which has elongated its stem sufficiently to keep its crown above a moving gypsum dune 30 feet high, the crest of which has passed it a few feet. The excavation has laid bare a trunk twice the ordinary length. White Sands of New Mexico (see page 693).



A REMARKABLE VINE, THE GUAREQUI (*Ibervillea sonoræ*), WHOSE LARGE EXPANDED STEM-BASE SERVES AS A STORAGE ORGAN (SEE PAGE 694)

carbonate that the tissue was unpleasantly gritty when chewed, and that its crispness made it difficult to express the juice.

E. flavescens (see page 700) forms small heads in clusters, while in *E. robusta* colonies 10 or 15 feet across, making mounds 2 or 3 feet high, include hundreds of heads.

No systematic account of any desert is to be found in which the storage function appears so highly developed and by so many species. Of course, all of the cacti exhibit this feature in a very marked degree, and a single plant of *Pilocereus fulviceps* may retain several hundred gallons of water. The large stems of *Yucca,* which is a prominent member of the flora of the slopes, function to this purpose to some extent, while the fleshy leaves of *Agave marmorata* and other species, and of *Hectia,* are essentially storage organs for reserve food and surplus water. Here is also a *Euphorbia* and a *Pedilanthus,* with thick upright cylindrical stems, in which the storage function is made more effective by the possession of a thick milky juice.

The tree morning-glory (*Ipomœa*) has a soft, thick trunk, into which a knife may be easily thrust to the hilt, the tissues being highly charged with water and containing some reserve food material.

Perhaps of all of the plants which show this capacity, however, *Beaucarnea œdipus* is the most remarkable. This relative of the *Yucca,* like all plants of this group with narrow leaves, is known as "sotol," and has the bases of the trunks swollen in adult specimens to a diameter of 7 or 8 feet, the topmost branch not reaching a height of more than 25. This trunk has a truncate base resting almost upon the top of the ground, to which it is attached by a few slender roots. After death, the loss of water reduces the weight of the storage organ so much that a large plant may be easily toppled over as it stands.

IN THE DESERT NEAR MITLA, MEXICO

As one proceeds to the ancient ruins of Mitla, 36 miles to the southeastward of Oaxaca, the aridity increases until in the vicinity of the hacienda of that name extreme desert conditions are found. The ancient structures here are indicative of a type of civilization characteristic of the desert, in which coöperation or communism was carried to as great lengths as it must have been in the pueblos of the northern deserts in America.

A short distance to the eastward from Oaxaca lies the village of El Tule, in which grow a large number of cypress trees (*Taxodium mucronatum*), one of which stands in the churchyard, and by the claims of local patriotism is the greatest in the world, while for a long time it has been cited as the oldest living. Both of these claims are incapable of actual proof, although the tree has much to justify an interest in it. Six feet from the ground it measures 154 feet in circumference, but it may be really two or three individuals fused together, as it divides into that many main branches within 50 feet. This tree has been an object of observation for more than two centuries, and on one side is a tablet, partly covered by the growth of the outer layers of the trunk, signed by the great naturalist, Baron von Humboldt, and probably placed there by his direction a century ago.

From El Tule to Mitla the way passes between fields illustrating methods of agriculture in an arid tropical climate. Not the least interesting of these features are the crops of maize of species either primitive or directly derived from one of the elementary species of *Zea.* The highway, especially where it passes through small villages or near a hacienda, is marked off from the fields and compounds by barriers of cacti grown in dense rows. Two or three species of *Cereus* and several prickly-pears are used for this purpose and also yield a valuable crop of fruit for the owners.

At Mitla the opportunity was offered for seeing the manufacture of mescal from *Agave.* Plants of several species and horticultural varieties of *Agave,* as well as of *Yucca* and *Dasylirion,* are uprooted at a time when the plant is about

A TREE-CACTUS NEAR TEHUACAN (*Cephalocereus macrocephalus*)

An epiphyte, a bromeliad, is seen attached to the branches

A MASSIVE TREE-CACTUS NEAR TEHUACAN, MEXICO (*Pilocereus fulviceps*)

Several hundred gallons of water are stored in its fiber (see page 697)

Echinocactus flavescens: TEHUACAN, MEXICO

Another kind of desert cactus which also stores many gallons of water for the long dry months

Echinocactus grande: TEHUACAN

A plant of great age and maximum size (see page 694)

to send up its long inflorescence axis and is loaded with sugary substances. The leaves and roots are trimmed away, leaving a huge core in the case of the large agaves. A large pit is heated by means of a hardwood fire built in it, and after being cleansed of ashes and the remains of the fire the cores are piled in the cavity and covered, and allowed to bake slowly for two or three days.

Next the pit is uncovered and the cores removed to a large vat made by sewing the edges of three or four cowskins together and suspending them from a framework of rough branches. Fermentation is allowed to act upon the sugary material for a week or ten days, and then the unpleasantly smelling liquid is dipped out and put in the kettle of a rude still, the cap of which is connected with pipes cooled with water run in wooden conduits from a stream near by. The resulting liquor contains a mixture of several alcohols and is exceedingly fiery, being a true whisky of a desert people.

TWO POPULAR THEORIES WHICH ARE ENTIRELY WRONG

The Colorado River cuts directly into the gravelly plain or mesa of the Sonoran Desert at four points on the eastern margin of its delta. At these places may be found within a compass of 100 feet the most vivid contrasts of rank swamp vegetation and water-loving plants having broad leaves and delicate tissues with the toughened, spinose, and hairy xerophytic forms of the desert. The presence of the moist area of the delta has but little effect upon the climate of contiguous arid regions, although a popular supposition to the contrary promises to be immortal. The relative humidity here is often as low as 17 per cent within 50 feet of the margin of the water.

GROUP OF DESERT VEGETATION ON LIMESTONE SLOPES NEAR EL RIEGO, TEHUACAN
Hectia, Agave, Yucca, Euphorbia, Opuntia, and a leguminous tree are to be seen

The armature of desert plants is often thoughtlessly cited as an adaptation by which these forms protect themselves against the ravages of animals. The presence of spines undoubtedly operates to prevent a plant from being eaten by animals, but the action of the animals has in no wise induced their formation by the plant. As a matter of fact, the fatality among desert plants by injury from animals is greatest in the seedling stage. For every prickly-pear that survives, tens of thousands of seedlings are eaten by rodents, and these seedlings are as unarmed as those of any other type.

CHANGE OF CLIMATE

A change of the climatic conditions throughout the Southwest, and especially in the semi-desert region of Arizona and New Mexico, is marked everywhere by the evidence of a much heavier rainfall than we now have. River valleys in many cases show only dry gravelly or sandy beds which evidently were formerly occupied by continuous streams. The floods that once carved their way across the slopes or over the plains are no longer seen, at least not in the same volume as in former time. Even existing streams do not reach in times of great flood their former volume and carrying capacity. All tell of diminished volume, whether in the desert regions or in the regions of abundant plant-growth.

We may believe that the cause is extraterrestrial and cosmic, and a part of the great era of climatic changes giving to the earth the glacial era, and its gradual decay. We may believe that the era of greatest precipitation in the Southwest and elsewhere was coincident with the widest extension of the glaciers and that while the higher mountains were being loaded with snow, the lower slopes were deluged with rain or watered freely by the melting snows and enjoyed a verdure no longer possible.

EXTINCTION OF THE GREAT MAMMALS

The fact of the existence and wide geographical range in Arizona of the great mammals, the mammoth and the mastodon, shows a very different condition of vegetation up to comparatively recent geologic time. The extinction of these giant herbivores may be best explained upon the theory of the desiccation of the region rather than by a change of temperature or increasing cold, as apparently was the case in Siberia, and may have been in the glaciated regions of California. A great change in the rainfall and the drying up of the slopes and mesas of Arizona must of necessity have caused a great change in the growth of plants, involving their destruction over great areas. It would appear that the extinction of the giant mammals and the disappearance of suitable vegetation for their sustenance proceeded together, and were due to increasing heat and dryness rather than to increasing cold.

We have ample evidence that in the Cretaceous era conditions in Arizona were favorable to forest growth and luxuriant vegetation. The coal-beds of Deer Creek near Saddle Mountain in Pinal County, described by Emerson, reveal such conditions.

Quantities of silicified tree trunks in the vicinity of Yuma and the prostrate forms of giant trees turned to stone in the Petrified Forest Park bear eloquent testimony to such forest growths and to destructive climatic changes in Tertiary time.

More recent evidence is found in springs surrounded by relics of vegetation, such, for example, as Andrade's Spring east of Tucson and on the right bank of Davidson's Canyon, where there is a thick accumulation of sphagnum with stumps of trees and, at the bottom, teeth of the mastodon.

The former existence in Arizona of a species of *Bos* of unusual size is shown by the discovery of enormous horn-cores in the gravels of the secondary or derivative slopes of the Santa Ritas at Greaterville.

THE CACTUS FLOWERS AND PRICKLY PEARS

The greatest activity among the cacti is displayed by the cereuses and opun-

tias. The earliest of these in the vicinity of Tucson is generally *Echinocereus fendleri,* in which a few brilliant crimson flowers are displayed from the clumps of short, thickened, cylindrical stems late in March, and continue for a month, to be accompanied and followed by equally noticeable bloom of two or three other small species (see pictures, pages 705, 710, 711).

Chief of the group, however, is the great saguaro, the flower-buds of which develop as dense clusters on the portions of the apices of the stems most exposed to the sun, and have been seen to open on March 25. The whitish flowers each remain open but a short time, and apparently are pollinated by insects. A succession of them ensues, and although practically finished during May or June, yet belated buds open at various times, one having been seen as late as the middle of November. The seedy fruits mature in great quantity in midsummer, and are much prized by the Papagoes, who make much use of them in various ways.

The prickly pears, or opuntias, with flat stems, begin to make some growth of new joints and to push out flower-buds in March, and late in that month or early in April bloom in great profusion, the fruits maturing early and dropping to the ground. Fifteen or twenty species are native to the Tucson region, but the greatest confusion prevails as to their identity. Of the various desert plants, this group has been the subject of the most inquiry as to its possible economic utilization.

After a consideration of the various practical questions connected with open cattle ranges, it has been found that the best use of them for forage is made by growing or allowing to grow spinose species, from which the spines are burned when they are to be consumed by animals. This is now done with the plants growing in various places. Unarmed forms are subject to the attacks of so many animals that it is practically impossible to secure a crop without protecting fences. A few species are known in which the spines are very sparse. One of these, *Opuntia lævis,* occurs in the canyons of the Santa Catalina Mountains, but chiefly on rocks or in places inaccessible to grazing animals.

THE SEEDS OF THE DESERT PLANTS ARE AS EXTRAORDINARY AS THEIR STORAGE ABILITY

Several species of birds make their nests in the branches of the cylindrical opuntias, where they are secure from hawks and marauding animals, and *many rodents of the desert drag the detached joints about their burrows, making an effectual barricade against the coyote and fox.*

The agaves form their great rosettes of thickened leaves on the slopes running up from the greater mesas, and after a period of development, which varies from a few to many years, a central flower-stalk is sent up in the foresummer with extraordinary rapidity, growing in length as much as a foot a day and quickly forming flowers and seeds. This effort exhausts the resources and terminates the life of the individual, and the entire cycle of these "century-plants" is directed to this one effort of arriving at mature size, with an accumulated food supply that will enable them to perfect a crop of fruits and seeds.

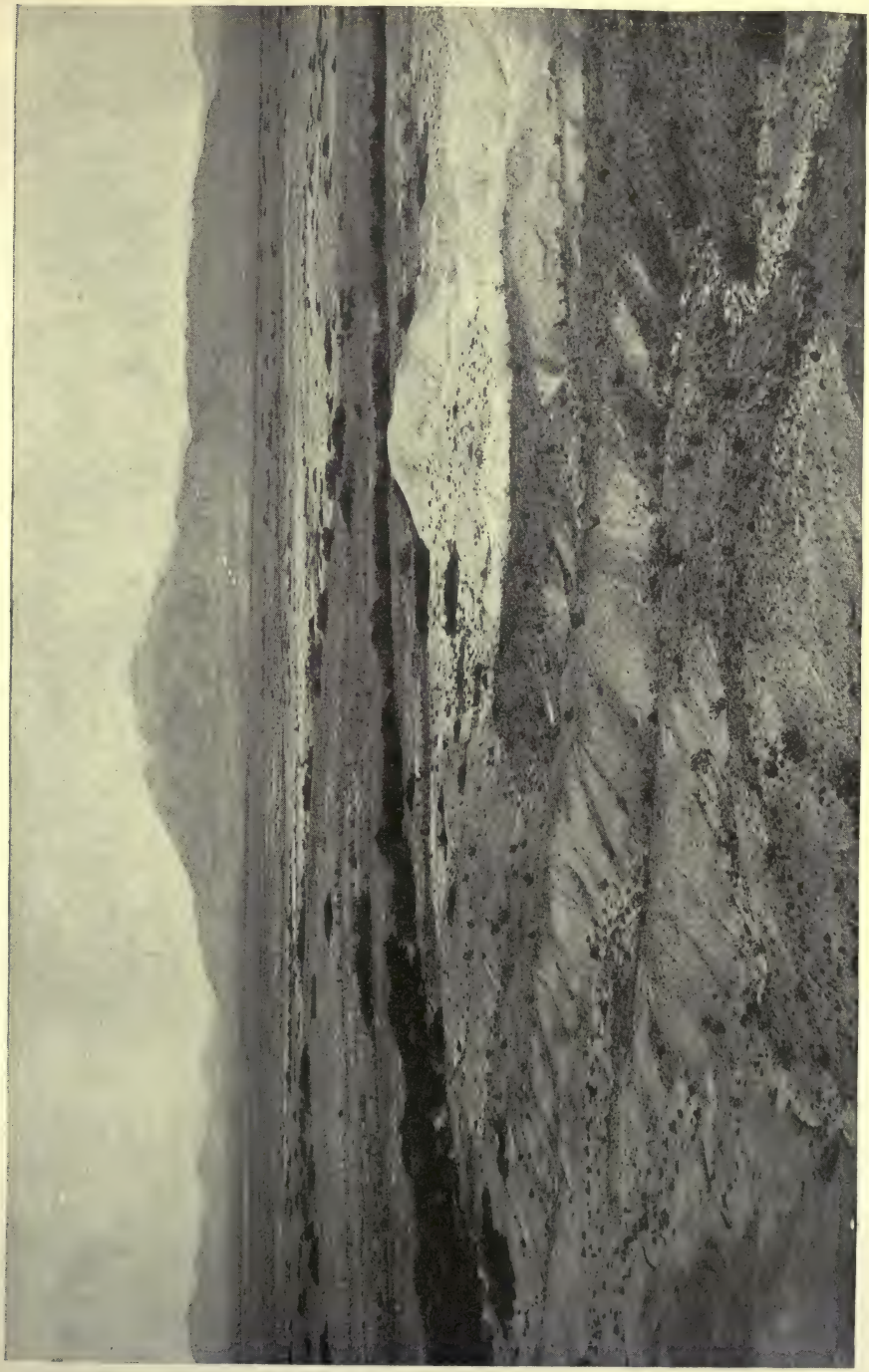
This habit makes the agaves an important source of food for the southwestern Indians, who take the rosettes when nearly mature, and, after cutting away the tips of the leaves, bake the central stem and attached leaf-bases for the sugary substances to be obtained, making what is known as mescal. The mescal-pits, used a decade ago, are numerous in the foothills of the mountains in this region, and even yet one may occasionally surprise an Indian feasting upon this prized delicacy (see page 712).

The seeds of the saguaro, which are produced in enormous quantities, are devoured by the birds before being freed from the fruits, but of the great number that reach the ground and germinate, not one in a million survives and makes the curious globular plantlet a few

THE MOST MASSIVE OF ALL CACTI, *Cereus weberi:* TOMELLIN, MEXICO

The human figures, which may be indistinctly seen at the foot of the tree, give an idea of the great size of this cactus. The numerous thick branches all arise from a central stem within a few feet of the ground.

CLUMPS OF DESERT VEGETATION NEAR LAS VEGAS, NEVADA: *Petalonyx nitidens* IN FOREGROUND



THE DESERT PLAIN OF LAS VEGAS, NEVADA, SHOWING EXPANSES OF LOOSE ALKALINE SOIL

OASIS OF PALMS (*Nerwashingtonia filifera*) IN THE MOUTH OF A CANYON NEAR INDIO, COLORADO DESERT

inches in height, eventually destined to become a giant cactus. The seedlings of all the cacti form a favorite food of a large number of small animals, being juicy reservoirs of water, and containing enough other material to lead to their destruction before sufficient armament has been formed for their protection.

The seeds of the winter annuals of the Desert of Tucson show amazing endurance. Seeds are ripened and thrown on the ground in March and April. The surface layers of the soil reach a temperature of over 100° F. during the summer months. The summer rains come and soak both the soil and seeds, but still no activity is shown, and the experimentalist who attempts to use these plants during the summer will find that he might as well have sown so many pebbles in his pans.

PORTIONS OF THE DESERT HAVE BECOME HABITABLE

Formerly the desert was held to be an uninhabitable place, but by the aid of the devices of modern civilization the requirements of life, comfort, and luxury may be transported to the most remote deserts, and large populations may carry on pursuits, such as mining, unconnected with the climate, regardless of aridity. One of the most important developments of modern agriculture is that of dry farming, in which forms of economic plants are sought which will produce crops under arid conditions, and constant and assiduous attention is being given to the development of cultural methods which will facilitate the growth of plants in deserts and conserve the soil moisture by checking evaporation. These and other individual adaptations of the human animal are of extreme interest, particularly when considered by the archeologist engaged in the study of the ancient civilization of desert peoples.*

One of the most difficult problems to solve is that of transportation in the desert, and there are extensive areas in American deserts that have not yet been systematically explored by reason of this condition.

The camel is perhaps the most extensively used of any means of transportation, and as such he has played an important part in the history of the human race in the arid regions of Asia and Africa. This animal has also come to be of great usefulness in Australia, where it was introduced in 1846, and a later importation of these animals, brought in 1860, accompanied the Burke and Wills Expedition across the continent.

In this same period efforts were made to make use of the camel in American deserts, and although the conditions were undoubtedly and still seem quite as favorable, the movement was a failure by reason of prejudice and of the organization of transport of burros, horses, and mules, already in a high state of specialization in this region. The extension of railways to tap mining regions and the usefulness of the modern motor car, as proved in the deserts of Nevada, now make any further consideration of the camel unnecessary along main lines of travel, while the solitary traveler or the small party following personal routes have available animals and supplies, so that the most economical outfit is that of horses, mules, and burros. A camel is reputed to be able to carry a load of 600 pounds with ease, but the same amount might be taken by three or four burros at a cost of original investment and maintenance only a fraction of that of the camel-train.

It is to be said, however, that a small efficient camel-train would make possible the scientific exploration of the deserts of western Sonora and of the region traversed by the Camino del Diablo with some certainty of success.

HOW LONG CAN MAN LIVE WITHOUT WATER?

A comprehension of the part that water plays in existence and travel in the desert is to be gained only by experience.

*C. S. Scofield: Dry Farming in the Great Basin. Bulletin No. 103, Bureau of Plant Industry, U. S. Department of Agriculture, Washington, 1907.

TWO CLOSELY RELATED PRICKLY PEARS GROWING WITH BRANCHES IN CONTACT, *Opuntia fulgida* (CHOLLA) AND *O. mamillata*

Both bear numerous maturing fruits: Tucson (see page 704)

SAGUARO, OR GIANT CACTUS (*Cereus giganteus*), NEAR MOUTH OF SALINA CANYON, SANTA CATALINA MOUNTAINS

The openings in the trunk and branches lead to large sac-shaped cavities, originally excavated by woodpeckers for nests, and afterward occupied by several other species, as well as colonies of honey-bees. This specimen is about 40 feet in height (see page 714).

CRUSHING THE PULP OF A DECAPITATED BISNAGA (*Echinocactus*) TO OBTAIN A DRINK IN CENTRAL ARIZONA

PAPAGO INDIAN DRINKING FROM A CACTUS (*Echinocactus emoryi*) WEST OF TORRES, MEXICO

*Some of the native animals, such as mice and other small rodents, have been known to live on hard seeds without green food for periods of several months, or even as long as two or three years, and nothing in their behavior indicated that they ever took liquid in any form.**

Deer and peccary are abundant in deserts in Sonora in which the only available supply of open water is to be found in the cacti. The endurance of the camel is well known, and some of the best authenticated evidence upon the matter comes from Australia. The camels of the Tietkins party in 1891 and 1892 made a march of 537 miles in 34 days without a drink. These animals take water every day when a supply is available, but it is their capacity for accommodation that has made them such a potent factor in transportation in the deserts of Asia, Africa, and Australia. Other animals, including the common domestic sheep, are also capable of making such changes in their habits that they may go for weeks without a drink.

Man and his most constant companion on the desert in America, the horse, are comparatively poorly equipped against the rigors of the desert. A horseman may go from the morning of one day until some hour of the next in midsummer and neither he nor his horse will incur serious danger; experiences of this kind are numerous. If the traveler is afoot, abstinence from water from sunrise to sunset is a serious inconvenience to him, and if he continues his journey, the following morning his sufferings may so disturb his mental balance that he may be unable to follow a trail, and by the evening of that day, if he has not come to something drinkable, he may not recognize the friendly stream in his way. Instances are not unknown in which sufferers from thirst have forded streams waist deep to wander out on the dry plain to a grisly death.

Some estimate may be made of the actual amount necessary from the fact that a worker at the Desert Laboratory during the course of an ordinary day in May, at Tucson, consumed 16 pints of water. A horse would have used 15 or 20 gallons in the same time. A walk of 3 or 4 miles was taken, but no special muscular effort beyond this was involved. A march across the desert in midsummer would increase this quantity by half. Under such circumstances, a canteen of less capacity than a gallon is a toy, and one of real usefulness should contain at least twice that amount.

The most notable example of endurance of thirst is that of a Mexican prospector hunting for a "lost mine" near the old Camino del Diablo, or trail from Sonora to Yuma, who made camp safely after being out for eight days with a supply sufficient for one. This experience is not likely to be duplicated soon, although it is reported that Indians often go as long as four days without water.*

The experience of the field expeditions from the Desert Laboratory demonstrates that saline or alkaline waters which contain as much as one-fourth of 1 per cent of salts may be used for periods of many days without serious discomfort, but if the proportion be increased to one-third of 1 per cent only hardened travelers may use it, while water which contains as much as one-half of 1 per cent is inimical to health and comfort, although it might suffice for a few hours or save the life of a person who had been wholly without water.

All devices for allaying the discomfort arising from the dryness of the mucous membrane, such as carrying bullets or pebbles in the mouth, chewing grass or a piece of rubber, are wholly futile in meeting the serious thirst problem. The relative humidity often falls to 5 per cent in the Southwestern deserts, and in a temperature of over 100° the evaporation from a vessel of water standing in the open may be as much as an inch a day. The amount thrown off by the skin is correspondingly great, and if the loss is

*F. V. Coville: Desert Plants as a Source of Drinking Water. Smithsonian Reports for 1903, pp. 499-505.

*W J McGee: Desert Thirst as a Disease. Interstate Medical Journal, vol. 13, No. 3, 1906.

not made good, thirst ensues, and ten hours' lack of water may thicken the tongue so that speech is impossible.

THE BARREL CACTUS

The Indian and the desert traveler often seek relief in the juices of plants when water fails. The fruits of some of the prickly-pears are slightly juicy, the stems of the same plant or the great trunks of the saguaro contain much sap, but for the most part it is bitter, and while it would save life, in extremity, yet it is very unpleasant to use.

The barrel cactus, or bisnaga (*Echinocactus*), however, contains within its great spiny cylinders a fair substitute for good water. To get at this easily one must be armed with a stout knife or an ax with which to decapitate the plant, which is done by cutting away a section from the top. Lacking a suitable tool, the thirsty traveler may burn the spines from the outside of the bisnaga by applying a lighted match, and then crush the top with a heavy stone. This or other means is taken to remove a section 6 to 8 inches in thickness. Next a green stake is obtained from some shrub or tree that is free from bitter substances, and with this or with the ax the white tissue of the interior is pounded to a pulp and a cavity that would hold two gallons is formed. Squeezing the pulp between the hands into this cavity will give from 3 to 6 pints of a drinkable liquid that is far from unpleasant and is generally a few degrees cooler than the air.

Scouting Indians have long used the bisnaga, and a drink may be obtained in this manner by a skilled operator in 5 to 10 minutes. Some travelers are inclined to look with much disfavor on the liquid so obtained, but it has been used without discomfort by members of expeditions from the Desert Laboratory. That it is often preferred by Indians to fair water is evinced by the fact that the Whipple Expedition found the Mohaves near the mouth of the Bill Williams River, in 1853, cooking ducks and other birds in the juice of these plants by means of heated stones dropped into the cavity containing the pulp.

The sap of the saguaro (*Cereus giganteus*) and of other cacti contains bitter substances that make it impossible to be used to allay thirst by man, although it may be given to burros. A supply is usually obtained by felling the heavy trunk and elevating the ends a few inches above the ground, while the middle is allowed to sag lower over a bucket or vessel that has been suitably placed in a hole in the ground below. A cut is made above the bucket to allow the liquid to escape, while the process is hastened somewhat by building a fire under the ends.

The experiences of the expeditions from the Desert Laboratory made it evident that a still or condenser, by which even a small quantity of drinkable water could be obtained from the abundant sap of these plants or from alkaline waters, would greatly facilitate field-work. After some experiment, one was designed by Mr Godfrey Sykes, in which the cactus pulp or liquid to be distilled is placed in a boiler of pressed steel. This apparatus is now used by the laboratory parties while at work in the deserts. It has a capacity of several gallons per day, which enables a party to make an extended stay at a locality where the untreated water is undrinkable.

CAMP FIRES ON DESERT AND LAVA*

THE expedition described in this most valuable book was an exploration of a genuine terra incognita, for while it is true that the Pinacate region, lying in the northwestern corner of Mexico, or, broadly speaking, in the Sonoran Desert between Tucson, Arizona, and the Gulf of California, was known to a few Papago Indians and several Mexicans, it was totally unknown to the outside world. There was no information whatever about this region, and on all available maps the space around the Pinacate dot was an absolute blank.

Naturally, the animal and plant life of the Pinacate region was as much unknown as its geography; hence the value of the results obtained to the botanist, zoölogist, sportsman, and geographer.

Mr Hornaday tells in a graphic way of the wonders of the desert region, of extinct volcanoes, the marvelous desert botanical gardens, and of hunting mountain sheep in the lava, together with chapters of absorbing interest on the legend and history of that country, the book being splendidly illustrated with photographs of the expedition.

Describing the desert vegetation, the author says: The White Brittle-bush, as seen standing alone on bare black lava, is truly a thing of beauty. It is hemispherical, symmetrical, immaculate, and clean as a new shirt. It is a big white bouquet. Its leaves are all on the outside, and although its branches are large and stocky—for the storage of water—they are so brittle that you can grasp a great handful of the outer stems and, with one movement, snap off every one of them as if they were so many pipe-stems of clay. The leaves are very large—for a desert plant—the blade being shaped like a broad arrow-head, one and one-half inches long by one and one-quarter wide. The flower is a little yellow composite, like a tiny yellow daisy, thrust far up on the tip of a frail and friable little flower-stalk six inches

* "Camp Fires on Desert and Lava." By Wm. T. Hornaday, Sc. D., pp. 366, 50 illustrations, 8 in colors. Charles Scribner Sons: New York. $3.30 postpaid.

THE WHITE BRITTLE-BUSH

Photo from D. T. MacDougal

DETAILS OF TYPICAL DESERT VEGETATION ON HILLTOP AT SANTO DOMINGO

Pack-Rats' nest; a new species of cactus—*Opuntia kunzei;* creosote bushes; skeleton of a dead tree, *choya,* in left middle distance; two white cottonwoods in distance, near river; and in upper right corner an *Opuntia versicolor*

VIEW OF PINACATE ACROSS THE LAVA FIELD, FROM THE TULE TANK

higher than the periphery of the foliage. We found few of them in flower, but enough for our inquisitive purpose. To the taste, the foliage is strongly aromatic, pungent, and bitter, and recalls the foliage of the common sage-brush (Artemisia). Apparently no animal eats the stems or foliage of the White Brittle-bush, and we are very glad of it, for it is truly a soft and pleasing thing to contemplate on the scowling lava-fields. The mountain sheep doubtless shared our views, since nearly every one killed was found to have browsed amply on the slender, delicate dead flower-stalks of the last season that still adhered to the stems and projected above the grayish-green mass. This bush is said to be widespread in the southwestern desert, but I did not notice it anywhere outside the Pinacate-Sonovta region, which may have been my fault.

Naturally, in such a wild and weird spot as the Pinacate region, every plant, tree, and living creature is of interest—rendered so by the grim surroundings and the intensity of the struggle to survive. It is fair to assume that the plant life we saw at the Papago Tanks represents only the bolder and hardiest species of the southwestern desert region, because were they otherwise they assuredly would not be there.

BOOK REVIEWS

Physical and Commercial Geography. By H. E. Gregory, A. G. Keller, and A. L. Bishop. Pp. 8 and 469, 9 x 6. Boston: Ginn & Co. 1910.

Most commercial geographies contain more or less physical geography, since without a knowledge of the physical environment no adequate study of the economic condition of a country can be made. But this is, we believe, the first commercial geography which has included the word "physical" in its title. The book is in three parts, the different parts having been prepared by the authors severally. They are as follows: (1) A description of the natural environment, physical geography, to which is devoted 123 pages; (2) the relations of man to this environment, to which is given an equal amount; (3) the products, industries, and commerce of the United States and the British and the German Empires absorb the remainder of the book.

This book more nearly meets the need for a text-book on its subject than any of its predecessors. Most of the works on commercial geography are, because of their fullness of detail, rather books of reference than text-books. This one treats few commodities, but representative ones, and few countries, but those the leading commercial countries. Special importance is given to the relations of man to his environment, the climate, fauna, flora, topography, water, etc., and his adaptability to changes in it. Means and routes of transportation and their development are discussed, and the increase of trade with increasing civilization. The book is illustrated with twenty-nine maps and diagrams. H. G.

Beyond the Mexican Sierras. By Dillon Wallace. Pp. 35 and 301, 5½ x 8. Chicago: A. C. McClurg & Co. 1910. Price, $2.00.

This is a narrative of journeyings in a little-known land, southwestern Mexico. The story is graphic and full of interest. The illustrations are abundant and excellent. Here is a region comprising many thousands of square miles very sparsely populated with Indians and full of big game; a region of the greatest agricultural and mining possibilities, lying undeveloped at our own doors. H. G.

The Indian and His Problem. By Francis E. Leupp. Pp. 14 and 369, 5½ x 8. New York: Charles Scribner's Sons. 1910.

The best book on the Indian that was ever printed. Mr. Leupp writes with fullness of knowledge of the characters of the Indians, of their history, and of the conditions which surround them. He thoroughly believes in the policy now in execution of making citizens of the Indians as rapidly as possible, consistent with their well-being. It is much to be regretted that Mr. Leupp could not have remained at the head of the Indian Office until this and other reforms with which he was identified could have been completed. H. G.

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THE NATIONAL GEOGRAPHIC MAGAZINE

NOTES ON THE ONLY AMERICAN COLONY IN THE WORLD

BY EDGAR ALLEN FORBES

With Photographs by the Author

"LIBERIA is an American colony." This brief sentence is not as commonplace as it looks. An American colony? Of course. Was it not founded by the American Colonization Society, in conjunction with the United States Government, on land "acquired by purchase from the lords of the soil"? Nobody else participated in its founding; even the West Indian settlers came at a later period.

As a republic it has a declaration of independence, a constitution, and a flag, all modeled closely after our own, and its people have never claimed kinship with any other hemisphere but ours. As a matter of fact, Liberia is the only place in the world where the American people have established a colony made up mainly of Americans. And yet, up to the time of Secretary Root, the most that an American Secretary of State would admit was this: *"To the United States it is an object of peculiar interest."*

Liberia is unique in another respect: it is the only part of the black man's continent that is now governed by the black man himself. All Africa is European except Abyssinia, Tripoli, Morocco, and Liberia, and the people of the first three are not negroes.

To one who has wandered about in Africa and realized that mission schools, Standard Oil, and Singer sewing machines are there the only reminders of the existence of an American republic, Liberia is a startling change. Elsewhere in Africa the United States is merely a geographical fact, and a fact of no consequence; its currency is good only here and there; its colloquial language is an unknown tongue; its most familiar institutions are as foreign as a Fourth of July celebration in Russia.

But sit with me on the balcony of the American Legation in Monrovia and remember that you are in Africa. This little capital, like the Monroe Doctrine, bears the name of a president of the United States. This main street, the Pennsylvania Avenue of the capital, has the name of Ashmun, who lies buried in New Haven, Connecticut. Yonder lagoon, Stockton Creek, which leads into the Saint Paul River, commemorates an officer of the United States Navy. The little strip of land beyond it, Bushrod Island, got its name from Bushrod Wash-

THE SUPREME COURT OF LIBERIA Photo by Edgar Allen Forbes

Chief Justice Roberts (a Georgian) in the center; Justice Tolliver on the right; Justice Richardson (on the left) is also President of the College of Liberia

ington. That building across the street is the "Executive Mansion". Glance at the flagstaff above it—the flag is the *star* and stripes. And where else, on the eastern side of the Atlantic, will you hear men talking familiarly about "the President," "the Senate and the House," and "the Supreme Court"?

All along Liberia's 350 miles of coast and up and down the sluggish rivers the story is the same. You are constantly passing little settlements that bear such familiar names as Virginia, New Georgia, Clay-Ashland, New York, Louisiana, Buchanan, Hartford, Greenville, and Lexington. And if you go ashore at Harper and Latrobe (Cape Palmas), in Maryland County, you can refer to Baltimore without explaining that it is a city in the United States.

And if you stop to talk with Liberians in any part of the country, you learn quickly that these are not the names of a glory that has departed. It is a curious fact that the American spirit is stronger in Liberia than in many parts of the United States itself. I once sat at a banquet given in Cape Palmas by Vice-President Dossen. As the speakers responded to their various toasts, it struck me that a chance listener would have imagined that this was a company of American negroes come ashore from some passing steamer.

Even the houses of the Liberians are different from those of Sierra Leone and other colonies; they are built in the style of the Southern States. Much of the furniture and the clothing and most of the books and papers that you see are from the United States. The filling of an American order requires months of waiting, the cost is higher, and the Liberians are poor people, but they want

Photo by Edgar Allen Forbes

THE LIBERIAN SENATE, IN FRONT OF THE SENATE CHAMBER
The tall man in the center is Vice-President Dossen

DR ERNEST LYON, FOR 6 YEARS AMERICAN MINISTER TO LIBERIA, AND HIS YOUNGEST SON

Photos by Edgar Allen Forbes

MISS ANNABEL LYON, CLERK OF THE AMERICAN LEGATION
She also looks after the social side of the Minister's household

what they want when they want it. Few of them have even seen or ever expect to see the United States, but they like to feel that they are still a part of America.

I shall not soon forget a feeble, gray-haired negro who hobbled up the steps and held out a hand that trembled with excitement. "I seed you on the porch," he said, apologetically, with that old-time negro deference, "an' I knowed you wuz sum o' mine—an' I'm some o' yourn." And I should like to remark right here that the negroes of Liberia are as polite and respectful to the white man as they are in Kentucky.

Photo by Edgar Allen Forbes

THE HOME OF THE AMERICAN LEGATION IN MONROVIA

It is owned by a negro farmer who left the United States as a freed slave-boy

It is sometimes overlooked that Liberia is one of the most interesting colonial experiments of modern times. There are three cities on that death-inviting West Coast that were founded as homes for returned slaves — Freetown, Libreville, and Liberia—all with prefixes meaning "free." Freetown was taken over by the British Crown more than a century ago because it then had the only safe harbor on the entire coast. Libreville went the same way when French imperialism awoke, and it is now the capital of the French Congo. Only Liberia remains free.

Wholly apart from our own connection with the establishment of the colony, it is interesting to read the declaration of independence of 1847.

"The western coast of Africa was the place selected by American benevolence and philanthropy for our future home. Removed beyond those influences which depressed us in our native land, it was hoped we would be enabled to enjoy those rights and privileges, and exercise and improve those faculties which the God of nature has given us in common with the rest of mankind.

"Under the auspices of the American Colonization Society, we established ourselves here, on land acquired by purchase from the lords of the soil. . . .

"In coming to the shores of Africa, we indulged the pleasing hope that we should be permitted to exercise and improve those faculties which impart to man his dignity—to nourish in our hearts the flame of honorable ambition, to cherish and indulge those aspirations which a beneficent Creator hath implanted in every human heart, and to evince to all who despise, ridicule, and oppress our own race that we possess with them a common nature, are with them susceptible of equal refinement, and capable of equal advancement in all that adorns and dignifies man. . . . Thus far our highest hopes have been realized."

"Thus far"—but that was 63 years ago. The agitation that preceded the Civil War came upon us then and the little African republic dropped below the horizon, there to maintain its struggle as best it could. What about its "highest hopes" today?

This was the question in my mind as I looked one night upon the dark outline of Cape Mesurado and waited on shipboard for the dawn. With eager interest I went ashore next morning, curious to see how the little experiment had turned out, and curious, as a Southern man, to see how the negro type had been affected in the second and the third generations.

Perhaps I should say frankly that I had gone to Liberia with the understand-

THE RESIDENCE DISTRICT OF MONROVIA

Photos by Edgar Allen Forbes

YOUNG OFFICERS FROM THE U. S. S. "CHESTER" ASHORE AT SIERRA LEONE

Photo by Edgar Allen Forbes

ONE STAGE OF LIBERIA'S WELCOME TO THE AMERICAN COMMISSIONERS
The men in uniform are local militiamen

SCENE IN A LIBERIAN VILLAGE

Photo from Captain Cloman, U. S. A.

LIBERIAN GUARDS AT U. S. LEGATION, MONROVIA

ing that it was the final, unmistakable evidence of the black man's inability to govern himself. Being familiar with the negro and his traits, it did not take long to grasp the significance of Monrovia. Since the freshness of those first impressions was lost in the intimate observation of the more stirring events that came afterward, I cannot do better than put down here what I wrote at the time.

There is much about Monrovia that reminds me daily of home, more particularly of my earlier home in the South. I see no real difference between the people of Monrovia and those of the same race in the United States. Even their shortcomings are homelike.

The capital presents from the ship's deck an aspect of quiet civilization that is in marked contrast with the clusters of thatch-roofed huts on the islands near by. The main street is lined with attractive cottages having large porches and balconies, with the Executive Mansion facing an open square. Beyond is the residence district—streets of frame cottages of which an English writer remarks that there is nothing like them to be seen anywhere else in Africa. The general average is about that of the homes of the most prosperous negroes in America.

The people of Monrovia look, dress, and act very like the better class of negroes of Atlanta or Louisville. All the Americo-Liberians (and many civilized natives) are neatly but not flashily clothed, and most of the aborigines put on an extra cloth when they come to town. I doubt if there be anywhere in the United States a negro community of the size of Monrovia where there is so little boisterousness, profanity, and indecency. Swearing is a lost art, and I saw but one case of drunkenness during my first month in Monrovia.

The Liberian Sundays suggest the quiet of a New England city—a quiet that is broken only by the sound of church organs and congregational singing. The churches are well attended, and the services are conducted with due regard to dignity and reverence. There appears to be a complete absence of the American saloon, of the degrading concert hall, and of the negro "dive." The Monrovian may not be a paragon of virtue and sobriety, but he is certainly a decent citizen.

It is well for Americans to know—and I say this with regret—that information about Liberia is not to be trusted if it come from European sources. There are some English gentlemen, for instance, who have had an object in persuading the outer world that the negro republic

THE RESIDENCE OF SENATOR S. G. HARMON AT GRAND BASSA
Senator Harmon is one of the wealthiest of the Americo-Liberians

SENATOR HARMON (IN THE CENTER) ENTERTAINING THE OFFICERS OF AN ENGLISH STEAMER

Photo from Captain Cloman, U. S. A.

VISITING A NATIVE TAILOR SHOP: LIBERIA

Note the sewing machine

Photo by Edgar Allen Forbes

TWO DESCENDANTS OF LIBERATED CONGO SLAVES: NEAR MONROVIA

was tottering on its last legs into anarchy and ruin.

Take just one example out of many that I could give. The leading merchant of Grand Bassa was expecting an important shipment of merchandise from Liverpool. The steamer that carried me into that port was expected to bring the goods. Instead the merchant received a letter from the Liverpool shippers saying that they deemed it inadvisable to fill his order until Liberia recovered from its turbulent condition. Now, to my knowledge, the whole land was as calm as Toronto on a Sunday, so I inquired into the cause of the Liverpool rumor.

And this was the cause: a delegation of dissatisfied farmers from some of the settlements up the Saint Paul River had come down to Monrovia, marched in orderly procession to the Senate chamber, formally petitioned that body to impeach President Barclay, and then quietly dispersed. It was the "tamest" sort of a political demonstration. I saw a larger one, gotten up by the opposite party to counteract the effect of the first, and it was about as tumultuous as a parade of the Order of the Eastern Star. Yet the British consul general cabled to Europe that Liberia was in a state of wild disorder and that the government was in imminent danger of being overturned.

Nobody outside of the British diplomatic service knows whether the fault lies with the Foreign Office or the Colonial Office, or with both, but nearly every foreigner in Liberia (except the English) will tell you that some one has unquestionably had a dream of seeing the English flag flying over the Executive Mansion in Monrovia.

Everybody knows how easy it is to lend money to a negro; knows also that the lending of money is a popular way that Europe has in playing the game of grab. In 1871 some bankers of London floated a loan of $500,000, with the export duty on Liberian rubber as security. Sir Harry Johnston, being an Englishman, cannot be accused of exaggeration when he says in his book that there was so much fraud in the transaction that $200,000 is a fair estimate of the money that actually reached Liberia.

Some later historian will show, in a similar way, how another British company defrauded Liberia in the loan of 1906 for another half million. The financial result of these two transactions is that, from two loans amounting to about half of Liberia's public debt today and on which the country is regularly paying interest to the British, the republic has very little to show. But the financial result proved to be unimportant as compared with the political result.

Here is what I found on arrival at Monrovia: British officials sitting at the receipt of custom; British army officers in command of the only regular troops; a British naval officer commanding the only gunboat; a British consul general dictating peremptory dispatches to the Liberian government after the fashion of Lord Cromer in Egypt.

CONDITIONS IN LIBERIA

Notes from the Report of the Recent Commission to Liberia—Messrs Roland P. Folkner, George Sale, and Emmett J. Scott

THE commission was impressed with the dignity and intelligence of the representatives of the government with whom it had dealings. Though these were relatively few in number, they represented the best of Liberia's citizenship, and the fact that the best men find their way into public employment is itself a favorable circumstance.

The Liberians are not a revolutionary people. Since the beginning of their

A SMALL PART OF THE METHODIST MISSION AT GARRAWAY Photo by Edgar Allen Forbes

Where Miss Anna E. Hall, of Atlanta, is directing one of the most successful tasks in the whole country

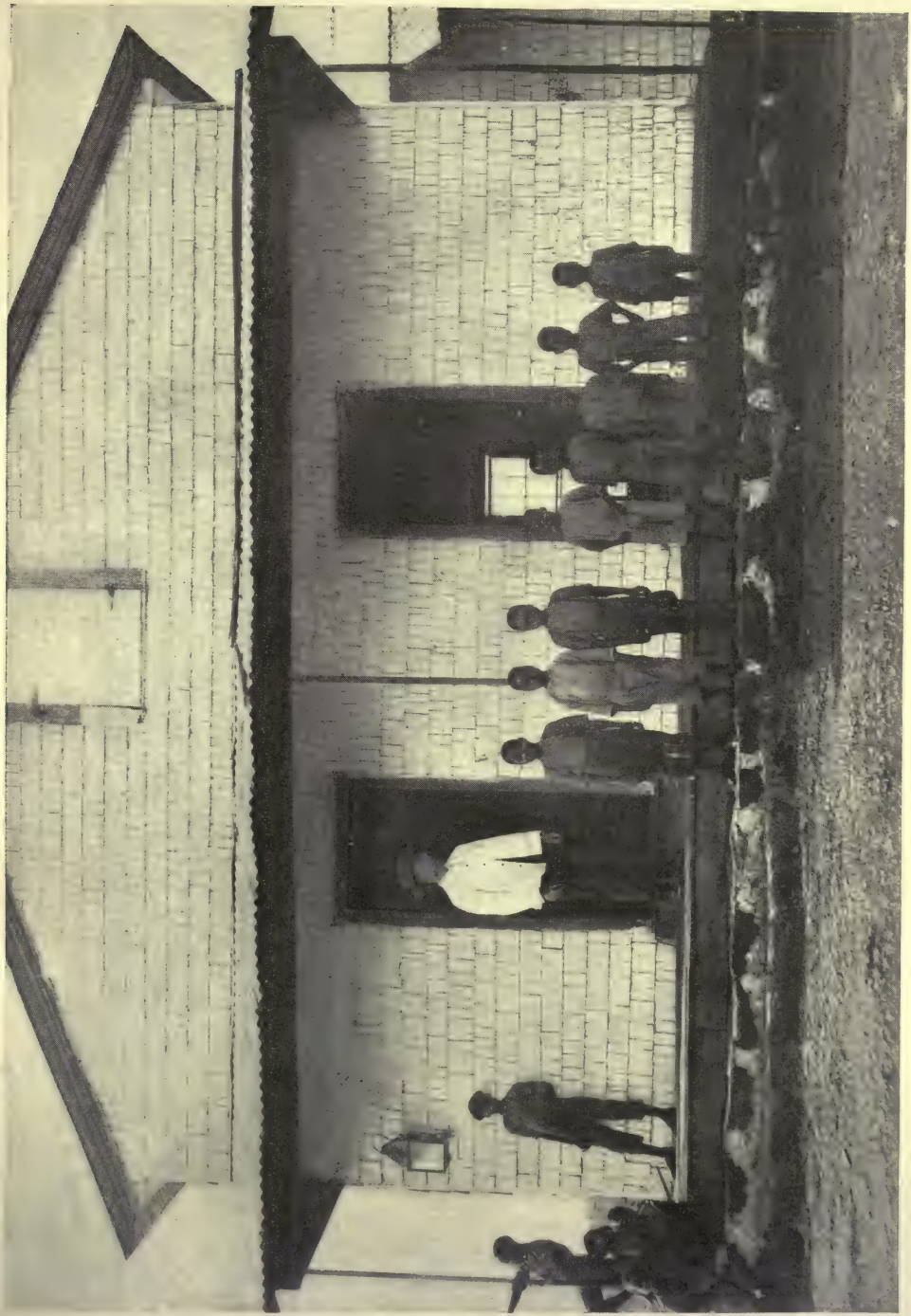

Photo by Edgar Allen Forbes

EIGHT SONS OF ONE NATIVE KING, IN THE LUTHERAN MISSION SCHOOL AT MUHLENBURG, LIBERIA

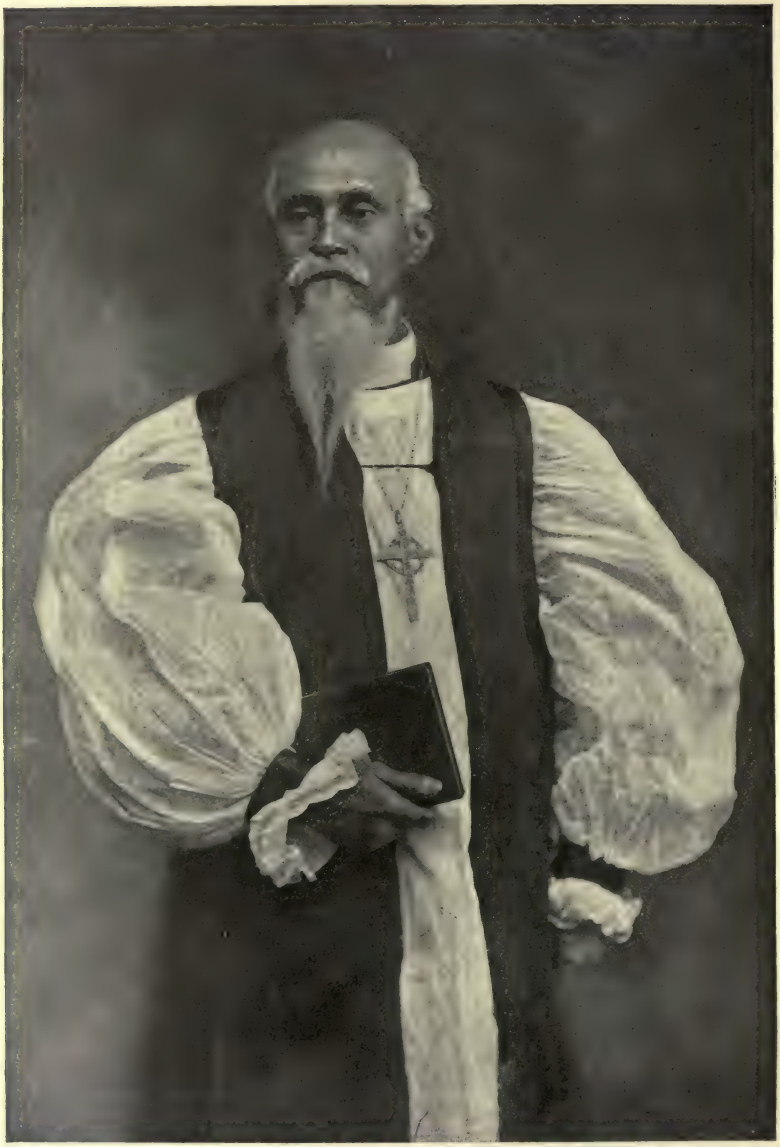

Photo by Edgar Allen Forbes

THE RT. REV. S. D. FERGUSON, EPISCOPAL BISHOP OF LIBERIA

He is a South Carolinian who has spent almost his entire life in Liberia. Although now advanced in age, he is extremely active and has a firm grip on his work. He has trained up a fine body of native clergymen.

national life they have maintained the forms of orderly government. In 62 years they have had 13 presidents, most of whom have been re-elected for one or more terms of two years each, and when changes of administration have been sought they have been sought by constitutional means. While under stress of public opinion one or more presidents have resigned their office, impeachment has been resorted to but once, and revolution not at all.

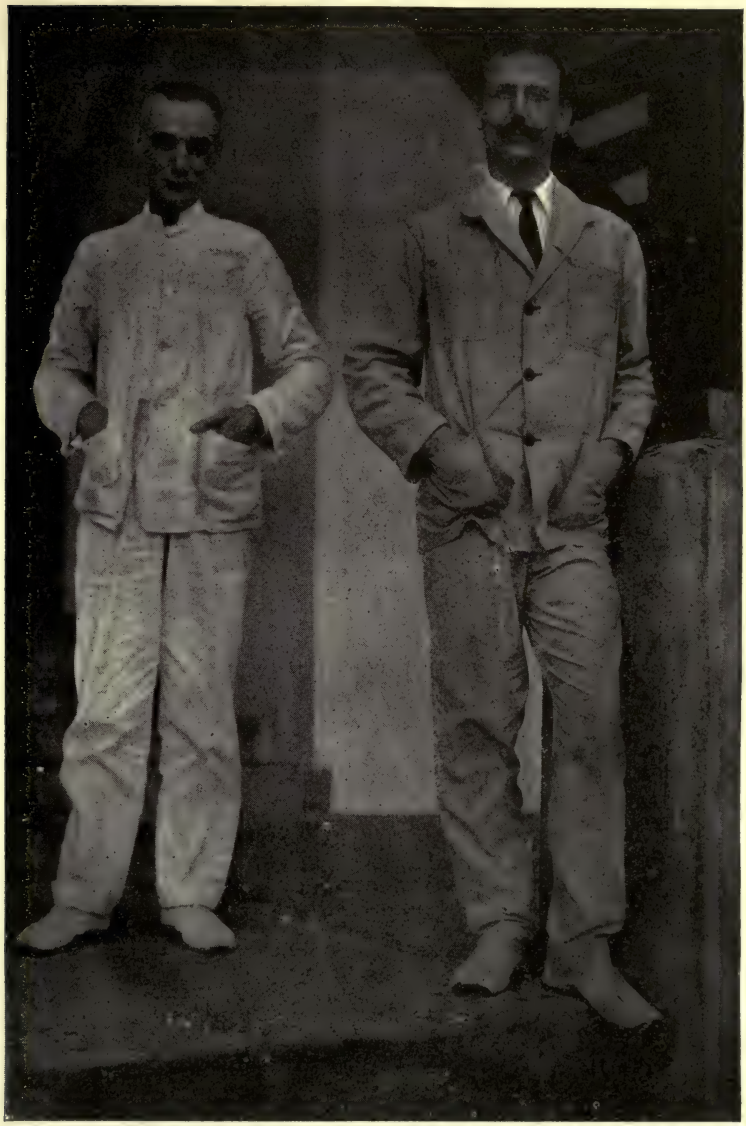

Photo by Edgar Allen Forbes

RECENT BRITISH REPRESENTATIVES IN MONROVIA
The gentleman on the right is Captain Braithwaite Wallis

Despite frequent assertions to the contrary, Liberia is not bankrupt. Much that is crude was discovered in the administration of the fiscal affairs of the republic. The government is embarrassed by its indebtedness and the burdens which it entails. But the national debt of less than $1,300,000 is not excessive, even if we compared it with the present revenues. In contrast to the natural wealth of the country, it is very small. Liberia is not a failure in self-government. It is true that the effective government of the country extends only to

Photo by Edgar Allen Forbes

GROUP OF OFFICIALS ON THE OCCASION OF THE VISIT OF THE GOVERNOR GENERAL OF FRENCH WEST AFRICA TO LIBERIA

the coast towns and settlements along the rivers Saint Paul and Saint John, but in these towns and settlements law and order prevail, life and property are adequately protected, and crime is promptly punished. Peace, good-will, and friendly feeling prevail between these towns and settlements and the native villages immediately adjacent to them.

However crude in many respects the civilization of Liberia may be, the Liberians have advanced, not retrograded, in their civilization. In estimating the progress of the Liberian people it is well to bear in mind their origin. The original elements of the population of Liberia were three: Free negroes sent out by the Colonization Society; Africans rescued from slave traders by the United States war vessels during the period of the suppression of the slave trade; freedmen who emigrated to Liberia since the war.

Out of these materials, guided by the traditions of life in America, the Liberian people have developed a civilization that compares not unfavorably with the better element of the negroes in the United States. It was the conviction of the commission and their associates that the Liberians had influenced the native population by which they were surrounded far more than the natives had influenced them. In the presence of that great mass of uncivilized people they have maintained a relatively high degree of civilization, of which the well-ordered home, the maintenance of law and order, the quiet Sunday rest, and the well-attended houses of worship are conspicuous signs.

It is the larger and more difficult tasks of government which now confront Liberia, chiefly as a result of the partition of Africa by European powers during recent years, which Liberia finds too hard for her. They grow out of the increasing importance of her relations with neighboring countries and the urgent necessity of more effective control and government of the native tribes within her boundaries. It is with reference to these tasks and problems growing out of them that Liberia feels the need of help from a strong power.

Photo from Captain Cloman, U. S. A.

RESIDENTS OF A VILLAGE NEAR MONROVIA

Specifically these problems are:

1. The maintenance of the integrity of her frontiers in the face of attempted aggressions of her neighbors, against whose might she can oppose only the justice of her claims.

2. The effective control of the native tribes, especially along the frontiers, so as to leave no excuse for the occupation of her territory by her neighbors.

3. The systemization of the national finances so as to render certain the meeting of all foreign obligations and to establish the national credit on a firm basis.

4. The development of the hinterland in such a way as to increase the volume of trade and thus supply the resources necessary for the increasing wants of a progressive government and at the same time enable the government to offer in-

CELEBRATING A HOLIDAY ON THE STREETS OF ACCRA, THE CAPITAL OF THE GOLD COAST COLONY

The Gold Coast, an English colony on the West Coast of Africa extending along the Gulf of Guinea, was discovered by the Portuguese in 1470, taking its name finally from the valuable deposits of gold discovered. This country, rich in gold dust, rubber, palm oil, and ivory, has a soil of great fertility, magnificent mahogany and palm forests, but to the white man a climate decidedly unhealthy. Coming down through the centuries this territory passed through many hands until in 1872 the Dutch ceded their last holdings and the rule of England was recognized as supreme, being named a British Crown Colony in 1874.

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ducements to desirable emigration from the United States.

Because Liberia has thus far failed in solving these problems satisfactorily she has found herself involved in controversies with foreign nations. These have created an unrest which hampers her internal development and have made her feel that her national existence is threatened by powerful neighbors without and by weakness within.

BOUNDARIES WITH FRANCE

To the north and east Liberia has France as her neighbor. In pursuit of their policy of building up a great West African empire, the French have been a thorn in the side of Liberia. They have

been consistent and persistent in their efforts to increase their boundaries. By successive treaties with Liberia they have deprived that country of territories long claimed by her. France has based its aggressions on the plea that the territory which she had annexed, and then had ceded to her by treaty, was not effectively occupied by the Liberians, and was therefore subject to acquisition by another power.

On the west Liberia adjoins the British colony of Sierra Leone. Even while Liberia was still a colony under the governors appointed by the Colonization Society she had trouble with Sierra Leone. British traders contended that Liberia had no right to impose customs duties, and refused to recognize her authority in this regard. The question thus raised was one of the main considerations which led to the formation of the republic.

Since Liberia has been an independent nation it has at several junctures been forced to make concessions to the ambitious designs of her neighbor. It is enough to recall the long dispute respecting the west boundary of Liberia, which was finally settled by the treaty of 1885, negotiated in its final stage at the cannon's mouth, whereby Liberia lost to Sierra Leone a considerable coast line to which she had an equitable claim.

The British Foreign Office has protested that Great Britain has no designs on Liberian territory. We find it hard to reconcile this protestation with the acts and attitude of her officials in Sierra Leone and Liberia. Certainly there is no difficulty in understanding Great Britain's declaration that if France is permitted to make successful advances into Liberian territory she will be compelled in her own interests to claim her share.

It makes little difference whether Great Britain is the upper or the nether millstone. Liberia is between the two, and it is the conviction of the commission that unless she has the support of some power commensurate in strength with Great Britain or France, she will as an independent power speedily disappear from the map.

The public schools of Liberia include Liberia College, in Monrovia, for higher education, four feeders or intermediate schools between the college and the lower schools, and the common schools. The college lacks the barest necessities in the way of equipment, and its courses of study scarcely equal those of a high school. The intermediate and common schools suffer for want of school-houses and efficient teachers. Annual appropriations for the support of schools are very small and are paid with much uncertainty. A radical reconstruction of its schools is one of Liberia's greatest needs. So long as the appropriations continue what they are, there can be little hope of the development of a proper system of public education. And so long as the revenues of the country are not materially augmented, there is little prospect that the republic will be able to make larger appropriations for this service. The best educational effort in the country is at the present time under church auspices, and some of the schools maintained by religious organizations are commendable.

Liberia's great source of wealth is her forests, which yield her palm oil, palm kernels, piassava fiber, and rubber. The gathering of these products is the work of natives, who sometimes labor under the direction of the Liberian, but more frequently barter the results of their independent toil with the Liberian or direct with the foreign merchant. Liberia fails to realize the full value of what she exports, because crude and wasteful methods of gathering these products and preparing them for the export trade deprives them of a part of their value.

The chief agricultural export of the Americo-Liberians is coffee. At one time the coffee industry was in a very flourishing condition, but is now stagnant or retrograde. The competition of other countries, notably of Brazil, which has brought to the world's market cheaper and better prepared coffees, has brought discouragement to the Liberian planter,

whose tiny crop no longer brings him those excellent prices which once rewarded his industry. He has grown listless and careless. He has not studied to adapt himself to the new conditions, and continues to cultivate and harvest the old crop in the old way.

The situation of coffee-growing outside of Brazil is far from hopeless, but planters elsewhere must be content with smaller profits than before and must meet the Brazilian competition by placing their product on the market in the best possible shape. Crude and antiquated processes prevail in Liberia, and it has done little to meet these conditions.

Liberia has little more than scratched the surface of its soil in a very small portion of its area. While not an extensive country, it is very inaccessible for lack of proper means of communication. Rivers are navigable for a short distance from the coast only before rapids are reached; rough roads in the civilized settlements and forest trails and paths in the interior country are the only avenues of communication. Wheeled vehicles are almost unknown, and, except for some water transport as the coast is neared, all the trade which flows from the interior comes upon the backs and heads of native carriers.

This woeful absence of means of communication restricts greatly the area in which trade can originate, as well as minimizes the influence of Monrovia in the interior and presents great obstacles to the effective control of interior points.

The difficulties of communication in the interior do not result from the topographical configuration of the country, but rather from the absence of highways through the forest country. As a result, the interior of Liberia is as little known to the Liberians themselves as to the world at large. What its extensive forests may be able to produce, what stores of wealth lie hidden in them, what value the cleared land would have for agricultural purposes they simply do not know.

A still further difficulty in the way of Liberian commerce is the want of harbors and the consequent difficulties of shipping goods. When produce has with great labor been brought to the coast towns, there still remains the task of shipment. This, on account of the shallow water on the bars at the mouths of the rivers, is a costly and often dangerous task.

There is every reason to believe from the natural fertility of the soil and the luxuriance of its vegetation that the country has great possibilities. But a more accurate knowledge must be had before they can be developed into fruitful sources of national wealth.

To the difficulties here enumerated must be added the lack of interest in industrial pursuits. The people are largely engaged in governmental and commercial pursuits. Trades and industries languish. Most of the skilled workers in Liberia are said to be from Sierra Leone. Nearly all manufactured articles are imported. While Liberia will never perhaps become a manufacturing country, greater attention will be necessary to the development of trades and industries before a high order of national thrift can be secured.

In the present economic condition of Liberia the commission is quite unable to recommend to the American negro any extensive emigration to that country. It believes that there is a field there for a large body of civilized negroes, but is equally certain that under existing conditions the emigrant who carries thither little beside his physical strength and his willingness to work out his own salvation would encounter little but hardship at the outset, and but a slim prospect of founding a comfortable economic existence for himself and his family. Liberia has much to do before it can offer tempting prospects to the would-be settler.

Its laws concerning immigration are fairly liberal and fairly intelligent. But its execution of the laws has fallen into disuse. One can imagine no greater embarrassment for the Liberian authorities than the unannounced arrival on their shores of a company of 200 or 300 immigrant laborers. If we can trust the statute books, land they have in abun-

dance, but it is unsurveyed, it is inaccessible for lack of roads, and covered with a dense forest growth.

The Liberians know too little about their own country and understand too little how to develop its resources to be able to render any assistance to immigrants. A systematic study of the resources of the country; a knowledge of its products and the best methods of gathering them; a knowledge of the possibilities of its land and how it can best be brought under cultivation; the construction of at least one good road into the interior, where better lands and more salubrious climate for man and beast are found—all these are necessary before Liberia can begin to offer inducements to immigrants. Liberia has neither the means nor the knowledge to enable her to prosecute such an effective study of her own country. No greater service could be rendered than to undertake for her such a study of her country as would enable Liberia to find herself economically, to enter into her own heritage, and to open hospitable doors to desirable immigrants from the United States.

Among its recommendations, the commission urges that the United States should establish and maintain a research station in Liberia.

The object of such station should be the scientific research of the natural phenomena of the country, the development and preservation of its sources of wealth, the effect of climate on health, and the causes, treatment, and cure of tropical diseases.

The United States has already in its brief career in the tropics made researches and discoveries which have enriched the world's knowledge of tropical conditions. It is to be anticipated that were a well equipped station established in Liberia, there would be further fruits of research which would redound to the credit of the United States. It would afford to the American student an opportunity for study of the natural products of the continent of Africa in one of its least explored and probably richest parts.

Nor is it to be overlooked that such a station would in a few years acquire a vast store of information for the instruction and direction of immigrants from the United States. Under favorable conditions Liberia can offer great advantages to our negro fellow-citizens. Until, however, the necessary information regarding the country can be placed before would-be immigrants in some systematic and effective way, attempts on the part of American immigrants to make a home in Africa must be attended with great probability of disaster.

THE GREATEST VOLCANOES OF MEXICO

With Text by Mr A. Melgareio, of Mexico City, and Photographs by S. L. Wonson, of Boston

POPOCATEPETL, the "Smoking Mountain" of the Aztecs, has only one superior in height on the North American continent—Mount McKinley, in Alaska—and only one rival, Mount Orizaba. In beauty it has few equals on earth. The Alps, the Himalayas, the Andes, and other of the great ranges present, without doubt, peaks of great beauty or peculiar formation, but few show the charming contrast of landscape peculiar to Popo, as the mountain is known locally. Its well-wooded slopes and foothills, the cultivated plains at its feet, with their patches of mellow green and yellow, its ravines and canyons and the lakes below are like a frame to its immense cone of reddish rocks, black sands, and its beautiful cap of white. The many towns and ranches around it and the railroads running at its base give it a peculiar "homelike" look, much dif-

NO. I. POPOCATEPETL, "THE SMOKING MOUNTAIN" OF THE AZTECS

NO. 2. VIEW OF POPOCATEPETL FROM THE HALF-WAY HOUSE

NO. 3. THE FRIAR PEAK OF POPOCATEPETL

NO. 4. THE VERTICAL WALLS OF THE IMMENSE CRATER OF POPOCATEPETL
The crater is more than one-half mile wide and one-half mile deep

NO. 5. "THE WOMAN IN WHITE"

NO. 6. VIEW OF "THE WOMAN IN WHITE" FROM THE RIM OF POPO'S CRATER

NO. 8. THE CRATER OF IZTACCIHUATL

NO. 7. THE STEEP SLOPE OF IZTACCIHUATL

NO. 9. THE PICTURESQUE COSTUMES OF THE GUIDES

ferent from the majestic wilderness of the average large mountains.

Easily accessible, it is often climbed. It is only a pity that lack of enterprise should so far have prevented the building of observatories at its summit, or even proper accommodations at its base for the mountain climbers.

Photo No. 1. Popocatepetl, with a heavy mantle of clouds, as seen from the summit of Iztaccihuatl. The opening of Popo's crater is plainly visible.

Photo No. 2 of Popocatepetl, 17,520 feet high, was taken from the half-way house, at Tlamacas ranch, at an altitude of about 11,500 feet. The peak on the right, "El Fraile," is about 15,000 feet high. Its brick-red, vermilion, and black rocks contrast with the glistening white cone above and the slopes below, which, covered with a layer of many feet in thickness of fine volcanic dust of a grayish black, give the mountain a quaint "velvet" look.

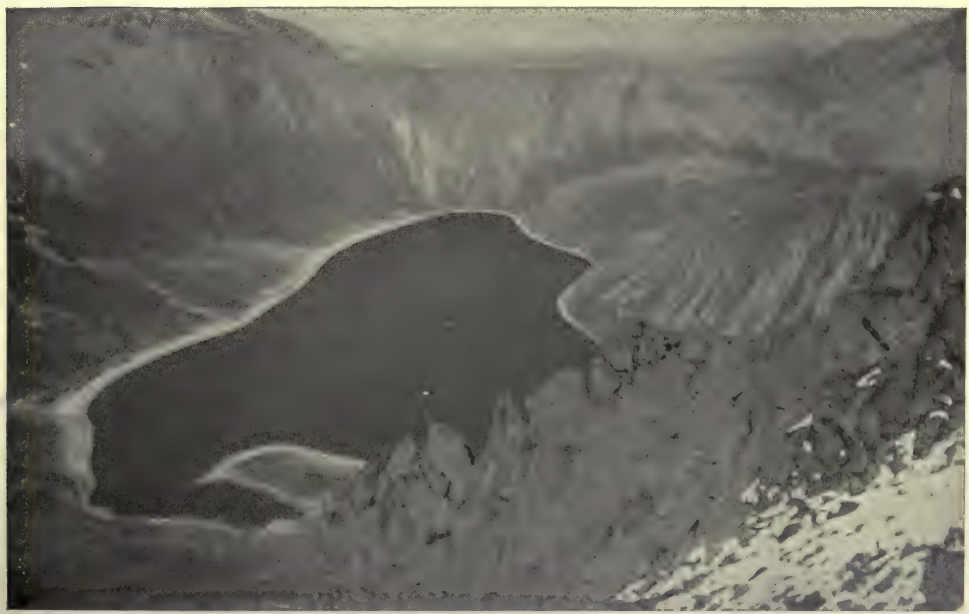
The half-way house, now an abandoned shack, some 25 years ago served as a storage house for the sulphur smelter installed at this point. All sulphur taken from the crater at that time was refined here, being native and of easy treatment.

Photo No. 3. "El Fraile" (The Friar) peak. About 15,000 feet. It offers opportunity for the most difficult alpine climbing. Below is seen the beginning of a great gulch, showing on its sides the extremely fine volcanic dust.

Photo No. 4. The south and western walls of the crater of Popo. The highest point shown on the left is the summit of the mountain, 17,520 feet above sea-level. Along these walls are numerous steam vents. At the foot of the walls on the eastern side are located the sulphur vents, from which thick white sulphur smoke constantly issues, and whence the native sulphur is taken. The crater, from the highest point seen to where the camera stood, its widest part, is estimated to be over 2,700 feet in diameter, being almost round in shape. Its depth to the lowest point visible is about 900 or 1,000 yards.

NO. 10. THE VOLCANO OF TOLUCA, OR "THE NUDE MAN"; NOTE THE HUGE CUP OR CRATER

NO. 11. VIEW OF THE GREAT CRATER OF TOLUCA



NO. 12. THE LAKE IN THE CRATER OF TOLUCA

NO. 13. THE HIGHEST PEAK OF TOLUCA

NO. 14. THE WHITE SURFACE IN THE FOREGROUND IS NOT WHITE, BUT SULPHUR CRYSTALS: ORIZABA

Photo No. 5. Iztaccihuatl, "The Woman in White," is the fitting companion of Popo. Its resemblance to a human form is remarkable, and the rugged, abrupt sides are in marked contrast with the graceful lines of the snow-covered body. It is located about 10 miles directly north of Popo and about 40 miles east of the city of Mexico. It rises to 15,082 feet above sea-level at its highest point, being, as will be seen from the above photograph, oblong in shape. Amecameca, the base of supplies, where horses, guides, etc., are obtained, and from where the start for the climb to both Popo and Iztaccihuatl is made, is seen in the foreground.

Photo No. 6. Iztaccihuatl, seen from the rim of Popo's crater. What appear like patches of grass on the sides of the mountain are in reality forests of the largest trees.

The great superstition of the natives has made them give all the rocks and peaks religious names.

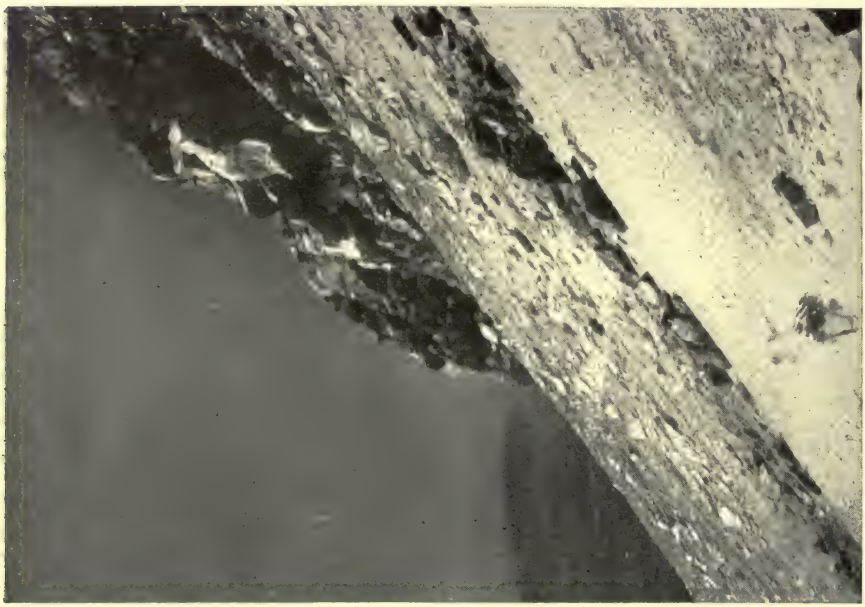
Photo No. 7. M. Rossi and guides. Showing the steep but even slope when heavily snowed.

Popocatepetl, although considered an extinct volcano, is in reality only dormant, as is proven by its great sulphur and steam vents. However, its great eruptions date as far back as 1548, and the last were recorded 108 years ago, in 1802. Iztaccihuatl is entirely extinct, its activity having ceased since the 17th century, and it is a matter of doubt whether it was then really active.

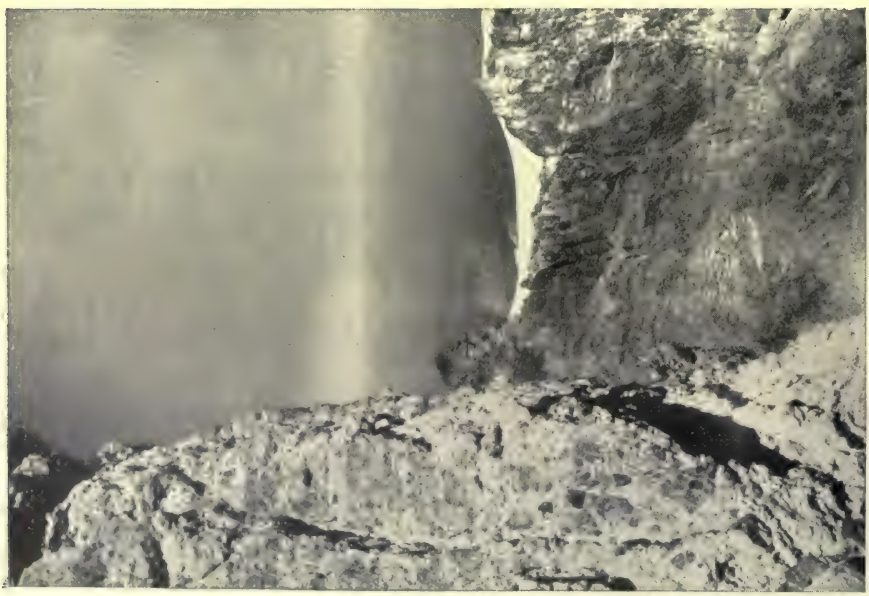
The mean altitude of the plains surrounding both mountains is about 7,500 feet, so that their absolute height above the valley is 8,000 feet for Iztaccihuatl and 10,000 feet for Popocatepetl. They form a more or less isolated chain, the so-called valley of Mexico lying on the west and the Puebla Valley on the east. North of Iztaccihuatl the plains are conspicuous, and south of Popocatepetl a great depression occurs, reaching to the "hot country," thus allowing a magnifi-

NO. 15. ORIZABA, "THE SHINING STAR"

NO. 16. VIEW FROM THE SLOPE OF ORIZABA, SHOWING POPOCATEPETL AND IZTACCIHUATL, 20 MILES AWAY



NO. 17. A DIFFICULT PIECE OF ROCK TO BE SURMOUNTED: ORIZABA



NO. 18. THE CRATER WALL: ORIZABA

NO. 19. THE SUMMIT OF ORIZABA, WITH THE CRATER EDGE IN THE FOREGROUND

NO. 20. TYPICAL VIEW OF THE SLOPES OF ORIZABA, BELOW THE SNOW LINE

NO. 21. THE VOLCANO OF COLIMA IN ERUPTION

The heavy clouds seen above the mountain are of smoke issuing from the crater. Photo by De Loe

NO. 22. THE ACTUAL "TOP" OF ORIZABA IS ABOUT 2 OR 3 FEET SQUARE

cent view of both mountains from the lands at an altitude of 5,000 feet and lower.

Photo No. 8. What was presumably Iztaccihuatl's crater, now filled in and covered up. The hump on the left, snow-covered, is one of the "breasts" of the mountain.

Photo No. 9. Mr A. Melgarejo at the snow line, about 13,500 feet. Showing the picturesque but cumbersome costumes of the guides. Under the worst conditions a pick and shovel are sufficient to insure a safe climb.

Photo No. 10. Xinantecatl, "The Nude Man," or Volcano of Toluca, lying about 30 miles southwest of the city of Toluca and about 90 miles west of Popocatepetl. The photograph, taken by Mr S. L. Wonson, shows plainly the great wide crater of the volcano, as well as the limit of vegetation, about 13,000 feet above the sea. The highest peak of this mountain, the dark, sharp peak on the left-hand side of the crater, rises to 15,055 feet. Its well-wooded slopes are magnificent cattle ranges on the side shown and good game preserves on the other side, the whole mountain furnishing first-class timber.

This is one of the oldest volcanoes in existence, there being no record of its eruptions, which, to judge from the size of its crater, must have been terrific. The ascent up to the interior of the crater is extremely easy, being done on horseback from Calimaya, a small town located northeast of the mountain, about 15 miles from the crater.

Photo No. 11. A general view of the interior of the crater. The foreground shows one of the two lakes which the crater contains. The largest of these two lakes lies behind the hill seen in the middle of the crater. On the left, above the snow, appears the highest peak. See photo No. 13.

Photo No. 12. General view of the great lake, which measures about three-quarters of a mile in length by about half a mile in width. Its waters are perfectly clear, and, due undoubtedly to the depth of the crater, as blue as the ocean. This reservoir must, through

its underground ducts, feed a large number of the streams at the base and sides of the mountain. Aside from this rippling lake, there is no sign whatever of life in this immense crater of Toluca.

Photo No. 13. "El Aguila." The highest point on Toluca's volcano, 15,055 feet above sea-level. After a leisurely ride from the plains below, the ascent to this peak is accomplished after a rough scramble of about two hours, its altitude above the level of the lake shown in photo No. 12 being only about 700 to 800 feet.

Photo No. 14. The author and guides at the crater's edge. The ground in front of the group is made of limy material as white as the snow in the background. Here is where the sulphur is picked, the entire surface being covered with layers of sulphur crystals.

Photo No. 15. Citlaltepetl, "Shining Star," or Peak of Orizaba, about 60 miles northwest of Vera Cruz, on the Gulf coast, 18,240 feet above sea-level. Located at the edge of the plateau, it rises 10,500 feet above the plains on the west, its eastern slope, extremely rugged and broken, running all the way to sea-level. All the big ranges being below the plateau, it stands alone with imposing majesty. Its shining cone is visible 80 miles out at sea, long before the land has come into view.

Its crater has the most irregular shape, very broken and jagged, and is smaller in diameter than Popocatepetl's, but about as deep as the latter's. Sulphur appears in crystallized form in layers at the crater's edges mixed with impurities of all sorts. Aside from some small steam vents, the crater shows no signs of life. However, from the fact that the cone is so well preserved and its proximity to the sea, it is not regarded as a dead volcano, but rather as a young one which may yet become active.

This photo was taken from the town of Chalchicomula.

Photos 16 and 20 show the general character of Orizaba on the side where the ascent is made. This being the southwest side, it is exposed to the sun's rays and to the warm south winds, which, melting the snows quickly, cause the running water to undermine the loose rocks, and, due to the great inclination of the mountain sides, these fall continually in avalanches, hewing the mountain. The north side presents the opposite appearance—that of a hump eternally covered with snow, as, due to the geographical position of the mountain, the sun seldom shines on that side. The ascent over these loose rocks is greatly fatiguing and slow.

Photo No. 16, where the arrow appears, on the left, shows Popocatepetl and Iztaccihuatl in the distance, 90 miles away, and to the right, in the center of the picture, Malintzi, about 55 miles distant. The latter is another extinct volcano, 13,510 feet high.

Photo No. 17. "The Pulpit." To attain the crater it is necessary to climb over the rocks seen on the left. These rocks offer a true alpine sport to the ones that conquer the summit.

Photo No. 18. This photograph offers a good idea of the uneven sides of the crater. Beyond the rim, on the opposite side, are seen the hills, the plains, and the sea, the latter being the dark strip beyond the white line marked by the cross on the right. This photograph is unique, showing as it does the height of the mountain above the level of the sea.

Photo No. 19. The Peak of Orizaba. The summit of the mountain and the walls of the crater are plainly seen. Notice the size of a human being, marked by the two arrows on top and to the left, in comparison with the surroundings.

Photo No. 22. The summit. Mr Wonson to the left, Mr Melgarejo to the right, and guides. A large cross, made of iron piping, was erected here by a pious German, but, undoubtedly struck by lightning, it has fallen to the ground in greatly distorted shape. The view obtained from this high point commands a hundred or more miles in every direction. The formation of the high Mexican plateau, the Gulf watershed, and the coast is here plainly seen. As shown by the photograph, the actual "top" of the mountain is about two or three feet square.

THE FRINGE OF VERDURE AROUND ASIA MINOR

By Ellsworth Huntington

WHAT kind of a place is this? Here we've been waiting in Girmeh over an hour and no one will bring us anything, not even bread and grapes and sour milk, although we are willing to pay well for them.

"No good sons of the Prophet would ever treat strangers so. We have traveled many moons in Anatolia and never met anything like it. To whom were you saying your prayers so piously when we arrived? Not to Allah, certainly. You think Baulo is a country place way off in the woods, but there they behaved like good Mussulmans. Here you act like infidels. We'll tell about you at the bazaar, and we'll put you in a book, so that every one will be ashamed to say he is from Girmeh."

Our strictures went home and there were many apologies. "We are poor," they said, "and have nothing to offer to such distinguished guests."

"Poor?" we answered. "Do poor men wear such splendid colored gowns as those which you have on? If you were poor could twenty of you sit around all day under the walnut trees by the fountain at harvest-time with nothing to do but say your prayers? Can men be poor who have such springs of pure water as this, and who own such magnificent orchards and gardens? Look down the mountain-side there and see those vineyards and all the trees. How many kinds have you?—walnut, fig, mulberry, pear, plum, apricot, 'little red' [a kind of bright red acid plum], and a dozen others. And who owns all those wheatfields on the terraces along the mountain slope between here and the pine woods? No, you are not poor, but simply rich and lazy."

"Well," they said, not altogether truthfully, "we might have brought some rugs for you to sit on, but all our goods are out in the garden houses, where we live in summer. We've sent a man to get you something to eat."

The villagers felt that they were wrong, for they knew that they had not acted according to the common practice of Mohammedans. Yet after all they did not care greatly, although they certainly objected to having a rival village praised at their expense, and to having the word go out at the neighboring bazaar town that their village was inhospitable.

Perhaps there was a tinge of malice in the remark which one man made to our Greek servant: "What big hats these men wear. They must be very great men, but the other foreigners who came here a few years ago were greater, because they had bigger hats."

Whatever their feelings, the people of Girmeh finally supplied our wants. They were evidently glad, however, when we went on our way westward through the beautiful pine woods on the mountain top, past the ancient and now waterless ruins of Cremna, and down into the barren land on the other side.

Girmeh lies about 40 miles from the Mediterranean Sea, north of the city of Adalia, which is located at the head of the great bay in the middle of the south coast of Asia Minor. To reach the village we had spent a hot morning in climbing nearly 3,000 feet westward up a steep slope of white limestone, from the valley of the Ak Su, which flows south through splendid forested hills to the plain of Adalia and ancient Pergamum, where Saint Paul began his famous journey in Asia Minor.

Much of the way the sun beat upon us from the bluest of skies, dimmed only by a summer haze which increased the feeling of languor occasioned by the warm, damp air. Often, however, we

A TURKISH MILL

A VILLAGE IN THE FORESTED BORDER OF ASIA MINOR

The rough shingles on the roofs are kept in place by rows of white stones

were in the shade of fine oriental pines, many of which have their branches bunched at the top in a form suggesting the palm. They were of a sunny yellow tint, washed, as it were, over deep green.

We were in a lovely land of sharp-cut cliffs of variously tinted limestone rising from rich green valleys, with pretty, prosperous villages here and there embowered in a wealth of trees. The ground, to be sure, was dry, and the abundant growth of spring grass had died entirely by the time of our visit in August, but trees and bushes were still verdant, and so, too, were the garden tracts watered by the great clear springs which determine the location of the villages.

Two days later we came to the village of Kuzzililar. It is only 50 miles southwest of Girmeh and 40 miles west of Adalia, but its scenery and the character of its people are absolutely different from those which have just been described. In spite of its nearness to the sea, the village gets little moisture, for it lies on the landward side of a range of mountains 10,000 feet high.

A gentle descent over treeless slopes brought us to an open plain, green with the reeds of a great swamp at the western end and brown with ripe wheat in other parts. The eastern horizon, toward the Gulf of Adalia, was black with the clouds and rain of a heavy summer thunder-storm, which cooled the plain but gave it no moisture. Westward the sky was clear except for a few light clouds, pink in the setting sun.

Here and there groups of harvesters with camels and donkeys were moving homeward toward the barren little villages of stone and mud nestled at the base of the mountains, where small springs furnish a scanty water supply. Elsewhere the villagers were still hard at work, eager to take advantage of every moment of daylight.

It was dusk when we reached Kuzzililar, a group of a dozen houses, with no verdure except a few willows and some fields of tall hemp surrounding every house. A harvester, just back from the field, pointed out the guest-room. It was so poor and forlorn that we did not wish to stay there.

"See," we said, "yonder is a good house, with two stories and an upper balcony made of wood. Let's go there and see if they won't take us in."

"Yes, it's a good place," answered the servants, "but don't you see there are 'black-eyes' there?"

Going nearer we hailed a young man, who evidently belonged to the house. He did not seem at all disposed to receive us, because, as he said, there was no room, and also the guest-house was empty. We were just turning away when a "black-eyes"—in other words a woman, so called because when she is properly veiled only her dark eyes are visible—looked over the railing of the porch and called out, "Let them come near, that I may see them."

She was the young man's mother and her word was law. On looking us over she decided that she wanted to see more of such odd-looking strangers, so up we went to the crowded porch, where most of the family appeared to be living. They moved inside, however, and left us in comfort.

When the head of the house, a keen old man, came from the fields, he began to reprove his son: "Why are the strangers here? Let them go to the guest-house, and not come here where the women are. There we will gladly bring them food and all things that we have. Why didn't you send them there?"

Just then his wife came up, and a single word from her turned him back to us with profuse apologies. "You are welcome indeed. I did not know who you were. I thought you were Circassians, come with tobacco to sell [an illegal and highly profitable traffic]. What village are you from? What do you bring to sell? Have the 'sharp flies' [mosquitoes] bothered you much? This wind will keep them away tonight. Is your village a large one? How many hours away is it? Make yourselves comfortable and soon my 'house' [that is, 'wife'] will have something ready to

eat. We are sorry that our fare is so poor. Come, let us look at your wares."

Great as was the poverty of this simple village and hard as the villagers worked, one felt that they were truly hospitable. Strangers were sent to them by Allah and were to receive the best that they had, and especially strangers who actually had nothing to sell and therefore must be great officials, perhaps on a secret mission. The old woman was simply delighted with a tin box and some sweet crackers that we gave her. The pleasure which she showed at the prospect of spending our present of a dollar in bargains for the children at the weekly bazaar proved how womanly she was, even though she did say her prayers like a man and rule the household with the hand of a tyrant.

The villages of Girmeh and Kuzzililar are typical of the two chief divisions of Asia Minor, both in scenery and in the character of the inhabitants. One division embraces the coastal region and the other the plateau. On all sides of the peninsula of Asia Minor, both on the Black Sea and the Mediterranean, mountains rise more or less abruptly to heights of from 4,000 to 10,000 feet. Their outer slope is comparatively well watered, because winds from the sea blow inward and are obliged to deposit their moisture by reason of the cooling which they suffer in the process of expansion due to rising. The case is exactly like that of Palestine and Lebanon, or like the mountains of California. Along the seaward slope there is a good amount of vegetation, and in many cases, where the mountains are of sufficient height, splendid forests form a belt from 5 to 30 or 40 miles wide. Beyond the crest of the mountains, where the inflowing air descends and therefore becomes warmer, the rainfall rapidly decreases and the country becomes dry and barren.

Hence the interior of Asia Minor, the great plateau some 3,000 feet above the sea, resembles the Syrian desert east of Mount Lebanon and the basin region of Nevada and Utah east of the Sierra Nevada in being much drier and less productive than the seaward slope of the country and in being practically devoid of forests.

During the visit of the Yale Expedition of 1909 to Asia Minor we saw an excellent example of the contrast between the coastal region and the interior immediately upon entering the country. We followed the famous route which leads from the northeastern corner of the Mediterranean Sea up through the narrow gorge of the Cilician Gates to the terminus of the Bagdad Railway at Eregli, on the southern side of the plateau of Anatolia.

Close to the sea lies the populous deltaic plain of Cilicia—warm, moist, and enervating—the product of hundreds of thousands of years of alluvial deposition by the rivers Sihun and Jihun. There are no more luxuriant grain fields, more fruitful vineyards, or richer gardens in all Turkey than those of Cilicia. The population is dense and comparatively prosperous, although not energetic. Factories of considerable size have recently been established, but it is interesting to note that it is not local initiative which keeps them up. The owners are largely men from Europe or Constantinople, and the employees are in good measure Armenians and others who come down from the poorer but more invigorating regions of the plateau to the north.

We visited Cilicia some ten weeks after the barbarous massacres of the spring of 1909, when 20,000 Christians, more or less, were slaughtered by fanatical Moslems at the behest of the former Sultan, Abdul Hamid II. In Tarsus and Adana, in the Armenian quarters, we saw street after street which had been reduced to a mere lane of ruined walls of mud and stone, seared by flame and blackened by smoke.

Within the open inclosures that once were houses a few miserable refugees were cowering under the open sky, enduring for a time in the hope that the reformed government of Turkey or the charitable Christian nations of Europe and America would aid them to build

AN ANCIENT INN IN THE TREELESS PORTION OF ASIA MINOR

A ROADSIDE FOUNTAIN

SWEEPING UP THE THRESHED WHEAT ON THE THRESHING FLOOR

A VILLAGE IN THE DRY PORTION OF ASIA MINOR

new dwellings and go on with their old life.

Some of the facts connected with the massacres illustrate the character of the Turkish people so forcibly that it is worth while to pause in our description of the country and record them. The facts belong to history, but they have a place in geography, because the character of any race is, in part at least, the product of the geographic environment under which that race has grown up, and of the movements of the race under the influence of geographic conditions.

In the more inaccessible parts of Turkey, especially among the high mountains which border the western plateau of Anatolia and which rise in all parts of the eastern or Armenian plateau, there are large numbers of people who are not Turks either in name or religion, and many others who are nominally Turks but are in reality the descendants of earlier races, such as the Phrygians, Lycaonians, Armenians, Karduchi, and Hittites. They have adopted Mohammedanism merely as a means of avoiding oppression and persecution.

The more open regions of the semi-arid center of the country are inhabited largely by people who are almost purely Turkish in race. These, as might be expected, form the backbone of Turkish power and the flower of the Turkish army. The character of the true Turk has doubtless been greatly influenced by his present surroundings, and has certainly been modified by Mohammedanism, with all its inheritance of the habits and modes of thought of the desert. Nevertheless it still bears deeply the impress of the physical circumstances which gave rise to the nomadism of his ancestors in Central Asia.

To turn now to the specific facts which are here to be used as an illustration of Turkish character: On April 16, 1909, there occurred in the city of Adana a massacre of Christians by Mohammedans. One cause was the fact that in 1895-'96, when extensive massacres took place in other parts of Turkey, there was none in Cilicia, and the Turks of that region said, "Let us have a massacre also and get rich by robbing the Christians."

Other causes were the jealousy of many Turks at the superior ability and prosperity of the Armenians, a strong but false impression that the Armenians were engaged in revolutionary plots, and the anti-Christian feeling fostered by Sultan Abdul Hamid for the purpose of recovering the power which he lost when he granted constitutional government. Under such conditions it was an easy matter for corrupt officials to carry out the express orders of the Sultan for a massacre of Christians. At the time of the massacre troops were already on the way from Saloniki to dethrone the old Sultan and reinstate the new constitutional régime. Part of these troops were promptly deflected to Adana by the controlling committee of the Young Turks in order to put a stop to disorders there. The troops were chiefly poor, stupid peasants—young, ignorant, and inexperienced—but they were supposed to be full of the spirit of progress and liberty and fraternity, and to be devoted to the new régime. What, then, was the amazement of men of all opinions to hear that these troops reached Adana on the morning of Sunday, April 25, took over the guarding of the city from the old troops who had helped to carry on the preceding massacre, and on the same afternoon inaugurated a massacre of their own.

What happened appears to have been as follows, according to the statement of the most reliable authorities, including American missionaries, the English consul, some prominent Armenians, and some of the more liberal Turks:

When the Turks disembarked from the railway which had brought them 40 miles eastward across the plain from the port of Mersina, many local Turks of Adana, especially the Khojas and Mullahs, or religious leaders, mingled with them and said, "Thank God, you have come. Now at last we shall be safe. For days and days we have been living in terror of our lives. These terrible Armenians have been burning our

THE CITY OF ADANA (SEE PAGE 767)

ARMENIAN REFUGEES LIVING IN THE RUINS OF THEIR BURNT HOUSE AT TARSUS

TENTS OF SEMI-NOMADIC TURKS AMONG THE HIGH MOUNTAINS NEAR ADANA

A STREET SCENE IN THE DRY ANATOLIAN PLATEAU

houses, robbing our shops, and carrying off our wives and daughters. Now you have come and we shall be safe, but look out that they don't shoot you unawares."

So it went on all day, for a deep plot had been laid by the reactionaries. About four o'clock a soldier was actually shot, not by Armenians, but, as is generally agreed, by some Turk who thought it worth while to sacrifice a soldier for the sake of inflaming the rest.

The plot was successful. The soldiers became fully convinced of the perfidy of the Armenians, their stolid minds were inflamed, and nothing but a massacre would satisfy them. The soldiers believed that they were slaughtering their enemies and the enemies of their faith. They did not stop to think or reason; they simply accepted what was told them by those in authority, especially by the religious leaders.

The Turk is a slow man, mild and gentle and easy to deal with on ordinary occasions, but when he is aroused he loses all common sense and is a mere wild animal. This contrast between his ordinary mildness and his occasional ferocity is the explanation of much in his history. Possibly it has something to do with the fact that for long ages before his arrival in Asia Minor, six or eight centuries ago, his ancestors lived the life of nomads in the deserts of Central Asia. Such a life consists chiefly of long periods of passive inactivity, when the cattle and flocks are grazing peacefully and a man has no need to think, for there is nothing to do except watch the women work. Now and then, however, there come periods of the most intense and exhausting activity, when the animals are lost or are in peril from storms, wild animals, or raiders. Then the nomad becomes well nigh a monomaniac, and will endure almost unlimited privation and distress to accomplish his purpose.

To come back now to the two divisions of Asia Minor, the Cilician plain belongs, of course, to the well-watered coastal region. Going northward across it, one soon comes to the narrow valley which leads up to the Cilician Gates. Magnificent pine trees cover the mountain slopes, for rain falls even in the summer, when most parts of Asiatic Turkey are suffering from four or five months of absolute drought.

On our first night out from Tarsus we slept on the flat roof of the khan, or inn, but had to get up in the middle of the night and carry our beds under the shelter of a booth of leaves. Twenty miles seaward or 20 miles landward there was probably no rain, but we were in just the position where the air rising up the slope of the mountains was cooled sufficiently to give up its moisture.

In the khans the talk was still of the massacres at Adana, and especially of the punishment meted out to some of those who had taken part in them. The Turks did not seem to be much impressed by the fact that six Armenians had been hung for shooting some of the Mohammedan mob, in the attempt to defend their homes and families and their own lives. What did impress them was the nine Moslems who had swung for killing Christians.

To many it seemed to be an absolutely new idea that a Turk could be punished for any wrong done to an Armenian. "What," they said; "hang a Turk for killing a Christian! It *cannot* be. They surely would *never* do that."

And then one of them, wishing to clear his own skirts, told how some one had offered him a horse stolen from a Christian at the time of the massacre. He had refused to buy it, although the price was extremely low, because, forsooth, it had been stolen. The man may have been lying, but the fact that he should think it worth while to lie in regard to such a matter is significant. Formerly he would have boasted of plundering Christians; but now a new spirit is beginning to spread abroad, vaguely and unconsciously, to be sure, but with possibilities of growth.

The gorge leading up to the Cilician Gates is a fine bit of scenery, much better illustrated by pictures than described by words. The gate itself well deserves

THE CILICIAN GATES (SEE PAGE 770)

A TURKISH FLOUR-MILL

its name, for it is in truth a gateway, the only passage for a hundred miles or more by which it is possible to cross with ease over the Taurus range, whether one be going from east to west or north to south. Darius, Xenophon, Alexander, the Crusaders, and many other invaders have used it as a matter of course, because there was no other route. Many of them left the record of their passing carved upon the stone, but most of the inscriptions are now obliterated.

The gate is a narrow canyon, with almost perpendicular sides, at the base of which it has been possible to build a roadway only by encroaching upon the space where the river once ran. The narrowness of the gorge and the steepness of its sides are due to the fact that just here the limestone which composes the mountains has been sharply bent down to the northward and broken off. An unusually hard layer which normally lies on top of the other rocks is thus tipped over until it stands almost vertical. During the course of ages the softer rocks on either side have been worn away, and this layer has been left as a ridge running nearly northeast and southwest and cut in two by the sharp, stream-worn gash of the gates.

The Cilician Gates have been much talked of in connection with the projected Bagdad Railway from Constantinople to the Persian Gulf. For years the railway has waited at the edge of the interior plateau, unable, as it were, to get through the peripheral mountains and down to the Cilician plain. At last, however, it is about to move forward toward Adana and Aleppo, and ultimately, after 10 or 20 years, toward the Persian Gulf. During the summer of 1909 surveys were carried across the Taurus Mountains and construction will now proceed rapidly.

The line will not pass through the Cilician Gates, as has often been supposed. About five miles to the east there is another gorge, deeper and more inaccessible than that at the gates, but occupied by a larger stream, the Chakit. This branch of the Sihun heads well back in the plateau and runs direct to Adana, the objective point in the Cilician plain. The Chakit gorge is so narrow and deep that it has never been possible to use it as a roadway. For a railroad,

MODERN GREEK FOUNTAIN IN PHRYGIA WITH ANCIENT PERSIAN LION BUILT INTO THE CENTER: THE BOY IS A GREEK

however, it is better than the Cilician Gates, because it has been cut to greater depth across the ridge of hard limestone, and hence the grades are not so heavy.

Even so, the engineering difficulties are formidable. From the divide on the plateau near the head of the Chakit River the descent amounts to nearly 5,000 feet in 70 miles, as measured along the river, without reference to the minor windings. In the 20 miles of the most inaccessible part of the gorge the descent is over 2,000 feet, so that the average grade is more than one foot in 50, which is very difficult for heavy freight. Even if the railroad is built with many windings, the grades will be hard.

The expense is bound to be immense because of the large number of bridges, viaducts, deep cuttings, and tunnel which will be required. The German and Greek engineers who are laying out the route say that the line as a whole will prove as difficult to build as any in Europe, except the Simplon, in Switzerland, with its long tunnel.

A BIT OF THE TREELESS PLATEAU OF ANATOLIA

A PROVISION DEALER

Beyond the Cilician Gates to the northward forests continue for 10 or 20 miles, but they soon disappear, because the rainfall diminishes rapidly as soon as the crest of the Taurus Mountains is passed.

At length the road, a well-made macadam highway, leaves the Chakit Valley, which it enters beyond the gates, and rises over bare hills unrelieved by any trees except an occasional bit of oak or cedar scrub. Shepherds begin to be seen on every side with their flocks.

Little farm-houses are no longer scattered about here and there wherever there is a bit of land smooth enough for cultivation, but in their stead villages are seen clustered about the occasional springs, where alone it is possible to get water throughout the year.

The houses are no longer built with sloping roofs, thatched or shingled to keep off the rain and full of half-hewn logs of fine timber. They are made of mud and stones, with scarcely a trace of wood except for the beams on which the flat mud roof is laid above a layer of brush. What need of a sloping roof where the rainfall is so scanty, and, if one is needed, how can it be constructed where there is no wood and all men are poor?

In traveling back and forth between the coastal fringe of forests and the dry plateau of Asia Minor, nothing is more impressive than the contrast mentioned at the beginning of this article. Not only are the scenery, the architecture, the methods of farming, and the whole manner of life of the inhabitants of the two regions highly diverse, but the character of the people themselves differs greatly. This may be due partly to inheritance, but much of it arises from the nature of the land.

The dweller in the open dry country is relatively poor; he often suffers from want, due to bad crops; he travels much from place to place with his animals, and the outlook from his door is broad, and he sees the stranger approaching from a distance and is not alarmed by his sudden appearance. Hence he is ready to share his meager supplies with others, because he knows the need of help, and his nature is comparatively unsuspicious and hospitable.

With the inhabitant of the forests it is different. He lives in comparative comfort and rarely suffers from actual want. He dwells apart oftentimes and at most sees few strangers. When they come to him he is worried and suspicious. He is not ready to receive them, because in his own experience and in that of his forefathers there has been little need of asking hospitality from others.

In these ways and a thousand others the life and character of men reflect the peculiarities of their land. The soul of the people can only be understood by looking through the eyes of Nature.

NOTES ON NORMANDY

By Mrs. Geo. C. Bosson, Jr.

THE early history of Normandy, even taking it only from the reign of Richard the Fearless (997), explains in itself why today, to those who look below the surface, Normandy seems in many ways a separate land from France. The 30 years of English occupation under Henry V have left their lasting impress, though its natural position demands that it should be an integral part of France.

That Norman power of adaptation to circumstance was the "fatal gift," so apparent in its Sicilian conquest, which has destroyed the Norman as a separate race. It has been said that "the finished historian must be a traveler," but one who possesses to the full the instincts of the

CASTLE WHERE WILLIAM THE CONQUEROR WAS BORN

Located in the old Norman town of Falaise, this picturesque stronghold occupies a commanding position on a rugged promontory and is of great historic interest

traveler must know his history as he knows with his own eyes the true look of a wide land.

Picture follows picture in the radiant Normandy landscape; the limpid light is at once brilliant and tender, and the eye feasts always on a banquet of color. Between slits of cliff are bits of sea, poplars shiver in the sun, meadows slope from height to ocean, longing for the sea, and the green roadway threads its path through all. It is not strange that Isabey and Daubigny found beauty here. In fancy Richard Sans Peur and "le Hellequin" still ride through the forests, and legends people every ruin. Less in the present than in the past, one dwells much on the stirring times when Normandy had a life of its own and the Norman name was famous from Scotland to Sicily.

Honfleur is a quaint port, with its famous Saint Catherine's Belfry—house, shop, warehouse all in one, while a delicately modeled spire crowns the whole. Villas line the hills, old gates and watch-towers yet remain of the Honfleur of great days. Beyond the quay bristle a hundred masts, sails drip with color, and the water is Nile green—a bit of Cairo in the north of France. Along the water front the same old houses which nearly 300 years ago were brave in their brand-new carvings, as they looked out to see the high-decked Spanish ships ride in, dipping their flags to the *fleur-de-lis* of France. Then Havre was only a strip of yellow *plage*, before the threatening sand bar stole Honfleur's harbor inch by inch.

Lisieux is one of the charming corners where something still remains of the Middle Ages, and in the church are windows depicting the marriage of Henry II and Queen Eleanor, and Thomas à Becket in his Norman exile.

The most personal beginning of the Norman conquest was at Falaise. There from a window of the lofty castle-keep Robert, Count of Hiesnes (later Robert the Magnificent and Robert *le Diable*), saw Arlette, the tanner's pretty daughter, washing clothes at the riverside. With all the settings of romantic legend she became the mother of that king whose bar sinister was blotted out in Conqueror.

At Caen we are in his footsteps. Saint Etienne contains his tomb, and has an interior remarkable for strength and solidity—a perfect example of the Norman-Romanesque, adorned (?) though it now is by 24 glass chandeliers of the 19th century's most lurid pattern. The Hotel de la Monnaie is a splendid house, built by a princely merchant, Etienne du Val, Sieur de Mondrainville, the man whose great wealth enabled him to get sufficient supplies into Metz for it to withstand its siege in 1553.

There is an atmosphere of heroes and kings in Caen. We see the tomb of the Conqueror and the house where Beau Brummel died. We see the ruined castle where *"le jeune et beau Dunois"* performed prodigies of valor, but on church walls are pasted the staring notices of *"loteries nationales de France!"*

Many French artists, archeologists, and men of letters are alarmed at the lack of consideration manifested by the state for the national monuments, which are being allowed either to fall into decay or to be restored with indiscretion. The great master Rodin is deeply concerned with this question, and in his desire to awaken public interest is about to bring out a series of essays (in his modesty he calls them "notes") on The Cathedrals of France, the study of which is his favorite pastime.

The walls that William built and Froissart writes about are a girdle that is lost today. The Conqueror's vow is brought to mind as one looks at l'Abbaye aux Hommes, and *vis-à-vis* l'Abbaye aux Dames, like the queen who builded it, sits on a throne.

It is at Bayeux, though, that one feels nearer that queen, Mathilde. Gray, dim Bayeux, old even then, when the Conqueror's queen was writing history with her needle. The first of the great French realists, she seems to me, in the naïve sincerity of those old tapestries, which truly are an epic.

HOTEL DE LA MONNAIE: CAEN

A distinctive example of the beautiful architecture of the Renaissance built in the sixteenth century. The ancient city of Caen on the River Orne was the favorite dwelling place of William the Conqueror and his last home. Caen, it is said, was founded by the Saxon Otlings between the third and seventh centuries.

BRETON COSTUMES WHICH ARE FAST BECOMING OBSOLETE

MONT SAINT MICHEL

This stark granite rock, upon which a fortress, an abbey, and a church were builded during five centuries beginning with the seventh, is justly called the Pyramid of France. Situated in the Bay Saint Michel within sight of the sea, it is seemingly the prey of the wonderful tides that sweep in faster than a horse gallops.

THE PORTE DU JERZUAL: DINAN

A gateway of great architectural interest, since it is Gothic without and Romanesque within. The old city of Dinan is what its name signifies, "The Fortress on the Water," being situated on the summit of a great hill of granite overlooking the River Rance. It dates from the Roman period and contains many architectural treasures.

Just a paragraph to percherons, between towns. For who can think of Normandy without them, the darlings! Along the smooth white roads they pass in sturdy line, with that majestic dignity only possible to thoroughbreds, whether horses or humans. Their mottled haunches and polished coats gleam like mother-o'-pearl, and their liquid eyes speak volumes to one who loves them.

Then Dives—Dives, with its inn of the conquering William, where Madame de Sévigné really left her patch-box, and one almost fancies the odor of rose leaves behind her—where the cook beats eggs in old Caen bowls that the china collector greedily gazes on, and where the exquisite tapestries ought to be put under glass. A château it was, built for the Conqueror while his boats were building that he crossed to England in, and over the door are still the arms of an old seigneur who married into the house of Savoy. Dives' port, now nearly choked with sand, was once a great haven. There William's fleet, assembled for the conquest of England, lay a whole month awaiting the favorable winds which never came until they had changed their position to Saint Valery.

Between Rouen and Havre is the pretty town of Caudebec, with quaint timbered houses and its broad terrace beside the river. On a market day, in the Grande Place in front of the church, is to be seen one of the few old-time sights of Normandy, the grand old church and the place itself contributing their share in the *ensemble*. But the traveler who would see this specimen of an old Norman town, wearing still its mellow and picturesque charm, must hasten thither without delay.

Mont Saint Michel, with its detached air, appears as though man and nature united in their work to build a masterpiece. Its one straggling street, that begins in the gateway of a king and ends—ah, that is the point. Where does it end? Three times did the vision of Saint Michel appear to Saint Aubert, commanding a church on the rocky heights. Hence rose that marvel of early Norman architecture, with its tombs of saints and heroes and brothers of kings, its Black Virgin, its Salle des Chevaliers with sunlit aisles, its cloisters and exquisite colonnades. As one thinks of the history that has peopled this pinnacled hill, emotions, impressions, and sensations crowd the mind, and surely the faintest imagination can fill the structure with the kingly shapes and knightly shadows of the Hundred Years' War.

Trouville, Deauville, Dieppe—in a short sketch of Normandy I purposely omit those gay bathing places, those "*doubles extraits de Paris.*" They are Watteau in the 20th century, though, and the salon of a casino in the height of the season is an animated and diverting scene.

In Normandy the artist may find congenial occupation and the opportunity, so difficult in these days, of sketching picturesque types—groups at the market place, groups at the inn doors, horses in clumsy harness, goats and sheep in biblical mélange. He will find doors and porches of so good a pattern and so old that they are new to the world of today. One may learn the value of variety in its simplest forms and realize the artistic worth of high-pitched roofs and contrasts in color, if it be only of dark beams against plaster, and of meaning in the lines of construction. But these treasures of Normandy are disappearing fast and must be quickly gathered.

In all the fair Normandy coast, each year more and more is there a disappointing note. One looks almost in vain for the old Normandy costumes; the blouse and the close white cap are all that are left now of the wondrous headgear, the short petticoats, the embroidered stomacher, the Caen and Rouen jewels of a generation ago. Modernizing destruction is rapidly blotting out the memory of old days!

OUR GREATEST PLANT FOOD

By Guy Elliott Mitchell

IN estimating the possible limit of American civilization, strength, and supremacy, has any economist ever recognized as a factor the phosphorus supply? Why, how absurd! Phosphorus? What has it to do with civilization? Its principal uses are for matchheads and as a fertilizer for plants. Ah, a fertilizer?

"Westward the course of empire takes its way—and leaves the ruined lands behind."

This is not a pleasing paraphrase, but it is true, and largely because those lands, after years of cropping, become deficient in phosphorus. Therefore it may be admitted that the government's present activity in applying conservation methods to the public phosphate lands, just as it does in the cases of coal and petroleum lands, is wise. But is it really necessary to carry out such drastic measures as are proposed for the phosphate lands and prevent the exportation of phosphate from government deposits, and thus unquestionably curtail the development of what is rapidly growing into a great American industry? Let us see.

The problem of farm production is the most important question which the American nation has to consider. It transcends all others, economic or political. If the broad farming lands of the Republic maintain or increase their fertility and productivity, all other problems will eventually right themselves more or less satisfactorily and the prosperity of the country be absolutely assured.

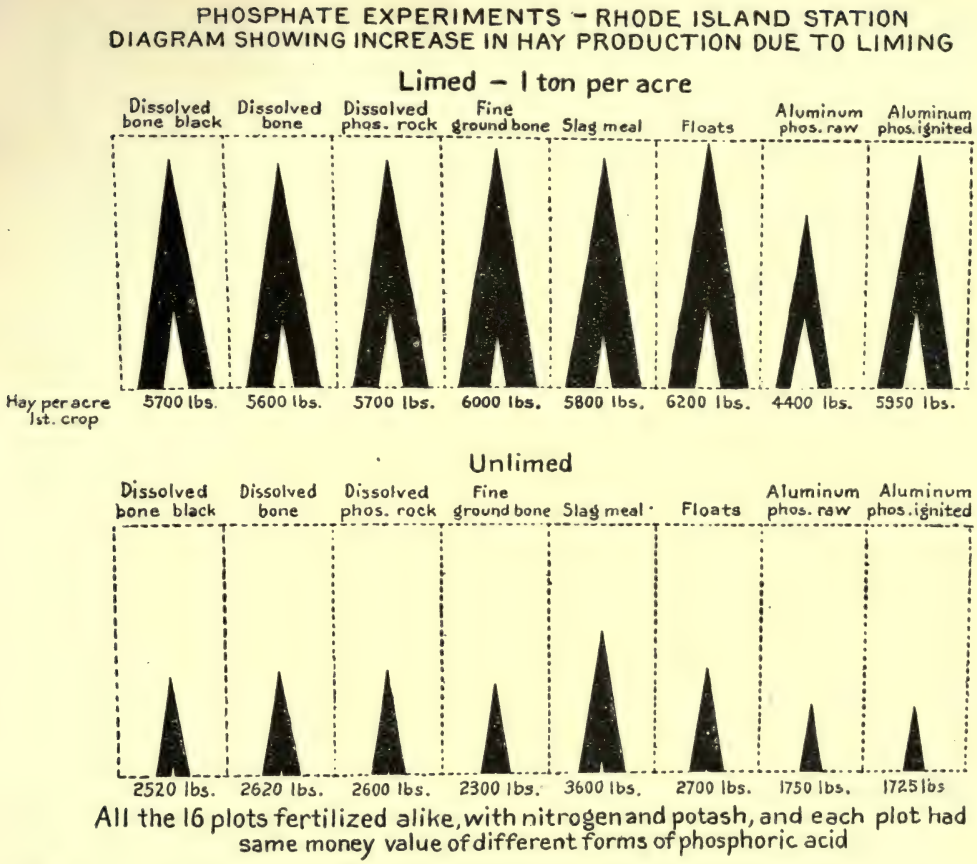
Phosphorus is one of three absolute essentials to plant growth. If you take a flower-pot of clean, sharp sand, containing no fertility, and add nitrogen, potash, and phosphorus, plants will grow and thrive. If you leave out any one of these three, the plants cannot grow. Now the natural supply of phosphorus is surprisingly, alarmingly small.

In the early alchemy of the earth, commencing when time was very young, and when the Archean rocks were just beginning to push their way upward through the universal Silurian sea, and then passing on down the inconceivable geologic ages to the advent of man—which was but yesterday—Mother Nature industriously and, in most instances, lavishly provided for all the necessities of the human family which was to appear. In most cases it is seen that she allowed a generous margin—enough to provide for use and abuse of the unreplaceable resources. On all sides the earth is found to be a vast storehouse of crude materials which, through the aid of human genius, are convertible into the necessities and luxuries of existence. But in stocking the earth with one necessary element Nature certainly overlooked entirely the attributes with which she was to later endow the human family, namely, his tendency in the midst of present plenty to disregard the future. This element is phosphorus.

"Now what new crazy scare is this?" exclaims the thoughtless optimist, the man who blindly preaches that human ingenuity will solve every problem as it is presented. "We are so tired of this talk of waste! waste! waste! Of being told that our forests are all disappearing; that our grandchildren will have no coal; that our iron supplies will not outlast the century. The earth and the air constitute a huge reserve of elements. When wood becomes scarce for building, if it ever does, its place will be largely filled by stone and other earth products; when the coal supply gets low, in 100 or 500 years, according to the various guessers, we will use electricity for power and the sun for heat; when the iron deposits become depleted, many centuries hence, we will perhaps have to stop building ridiculous sky-scrapers, and will then erect

WHEAT YIELD INCREASED 133 PER CENT BY PHOSPHATE

Wheat-growing experiments at Urbana (Illinois) Agricultural Station, on land where cow peas had been plowed under. Land shown in upper picture was given an application of lime, and yielded only 9.2 bushels of wheat per acre. In lower picture lime and phosphorus were used together, and yield was increased to 21.5 bushels per acre.



HAY CROPS MORE THAN DOUBLED BY USE OF PHOSPHATE

This diagram affords an interesting study. In reality a liming experiment, it shows phosphorus to be a controlling factor in production of the highest importance. It will be noted that "floats," or raw phosphate, gave the largest yield.

substantial buildings of masonry; when the oil and the natural gas wells run dry, electricity will be gathered from the clouds. We are but in the infancy, on the threshold of discovery and invention. Phosphorus! Brimstone! Let the parlor match become a lost art; man will strike a light from the sun!"

So he will, doubtless; but when the housewife ignites her sun-cooker she must still have bread to bake, meat to roast, and vegetables to boil in plenty, else our people will be illy nourished and our world-pace will slacken and cease. And this is the problem into which the phosphorus supply enters—food.

There are three necessary elements to the production of plant and therefore human food, and only three; but all the discovery and invention and genius in the world, added to all the knowledge that may be obtained from the Martians and other beings, cannot supply substitutes. They are nitrogen, potash, and phosphorus. And, in supplying the earth with just enough of the last-named, and no more, Nature forgot that she was going to instill into man the spirit of wastefulness; and so she has, by limiting her supply of phosphorus, in reality fixed the limit of human existence. Man can lessen or extend that limit as he wastes

or conserves his meager store of this most precious element.

Now how much phosphorus is there? The lithosphere, or outer crust of the globe, holds enormous available supplies of nitrogen, and contains nearly three per cent of potash, well distributed and available as plant food. These supplies are inexhaustible.

But it contains only about one-tenth of one per cent of phosphorus. This is phosphorus enough to grow perfect crops, but there is practically no margin for waste.

Yet the waste is large and constant from every American farm acre, and, under the present practice, the end is in sight for American agriculture—not a thousand years hence, but almost now. In fact it has come to some farm sections. Science realizes it and is preaching the danger, but the people, the producers, cannot see it. Dr. Hopkins, of the Illinois Experiment Station, demonstrates the fact on the so-called inexhaustible black prairie bottom lands of fertile Illinois. What then of the long-cropped lands of New England and the more southern Atlantic Coast States? Let us see what the cold, uncontrovertible facts show with relation to the degeneration of the rich and comparatively new farming lands of Illinois, then apply the information to the rest of our farm area, and see how long under present practice we will be able to maintain our agricultural supremacy, and therefore our prosperity as a people. And then, while there is yet time, let us supply the only remedy.

The average of the different kinds of Illinois soils contains 1,191 pounds of phosphorus per acre for the surface 7 inches of dirt. But a 75-bushel crop of corn, for instance, will remove from an acre of soil 17 pounds of phosphorus, and, at this rate of cropping, the total phosphorus content of that soil would be exhausted in 70 years. If the grain is fed on the farm a good proportion of this plant will be returned to the soil. To prove that in actual farm practice the rate of exhaustion is startlingly rapid, a series of soil analyses in three States is cited by Dr. Hopkins, and they show that ordinary cropping for 54 years took away 36 per cent of the original phosphorus content of these soils.

Now, to replenish soils depleted of this necessary element through cropping, we must draw principally upon the natural supplies of concentrated phosphorus. The greatest source of phosphorus is phosphate rock, the petrified remains of myriads of antediluvian animals, and the principal deposits of phosphate rock are found in the United States. Again, the greatest of these have been but recently discovered in the public-land States of Wyoming, Utah, and Idaho. This field embraces the largest area of known phosphate beds in the world. The United States produces more phosphate than all other countries together. To merely offset the rate of loss above mentioned and maintain the present fertility of all the cropped land in the United States would require the use of over 12,000,000 tons of phosphate rock annually.

But people say that there are inexhaustible supplies of this phosphate in the great deposits of Florida and other States. There are, it is true, large deposits of this precious mineral, but the supply is far from inexhaustible; it is distinctly limited and all too small. Moreover, heavy inroads have been made into it, and the worst of the situation is that one-half of the phosphate mined in America is being exported to enrich the worn-out and competitive lands of foreign countries.

"American phosphate for the American farmer" is a good cry; it might well be adopted, not as the warning of the sentimentalist, but as a grim slogan of self-protection.

The Geological Survey's last estimate, admittedly conservative, for the total tonnage of the high-grade phosphate deposits of the United States, was less than 150,000,000 tons—a 12-years' supply to offset our present waste. Since then geologic work has developed large deposits, notably in the public-land States of Wyoming, Utah, and Idaho; so that it

TURNIPS AND CLOVER RESPOND HEAVILY TO PHOSPHATE STIMULATION

Experiments of Maine Agricultural Station with phosphorus in which raw rock phosphate applications shows the heaviest yields.

Turnips: Box 1, dissolved phosphate; box 2, raw phosphate; box 3, insoluble phosphate of iron; box 4, no phosphate.

Clover: Box 1, dissolved phosphate; box 2, raw phosphate; box 3, insoluble phosphate of iron; box 4, no phosphate.

may be reasonable to make a guess of the existence of double this figure, or 300,000,000 tons. But every ton of this will be needed on American farms, and it should be our hope that other great deposits may be discovered which will yet again double this tonnage.

And exportation of this vital element should be stopped.

The following tables, compiled from the figures of the Geological Survey and the Bureau of Statistics, show the production and exportation of high-grade phosphate rock:

Production and Exportation of Phosphate Rock in United States

(From the beginning of the industry to 1900, the production was 14,993,396 long tons; export figures covering this period are incomplete.)

Year.	Production, long tons.	Exportation, long tons.
1900	1,491,216	776,220
1901	1,483,723	624,996
1902	1,490,314	747,672
1903	1,581,576	817,503
1904	1,874,428	849,130
1905	1,947,190	879,979
1906	2,080,957	964,241
1907	2,265,343	900,983
1908	2,386,138	1,188,411
1909 (estimated)	2,500,000	1,300,000
Totals	19,100,885	9,049,135

We have thus mined 34,000,000 tons of phosphate, while during the past ten years our exports have been one-half the production. But how can exportation be curtailed? Obviously you cannot successfully appeal to a New Jersey corporation backed by foreign capital and organized for the purpose of mining and exporting Florida and Tennessee phosphates, and which owns the phosphate deposits.

Yet something can be done, and the prospect is one to arouse the enthusiasm of every American. Through great good fortune the nation still owns by far the largest portion of the phosphate lands, and it may yet go down in history as the greatest act of President Roosevelt's administration that he withdrew from entry all known public phosphate lands with a view to asking legislation which would allow their mining only on condition that not a pound of the phosphate should be shipped beyond the borders of the United States.

In December, 1909, on the recommendation of the Geological Survey, 4,541,300 acres of public land in Wyoming, Idaho, and Utah, known to be in part at least underlain with phosphate beds, were withdrawn from entry. Upon further investigation 2,570,017 acres of this were found to be non-phosphate, and were promptly restored, while 400,000 additional acres of phosphate lands have since been withdrawn in this western field, besides 2,400 acres in Florida.

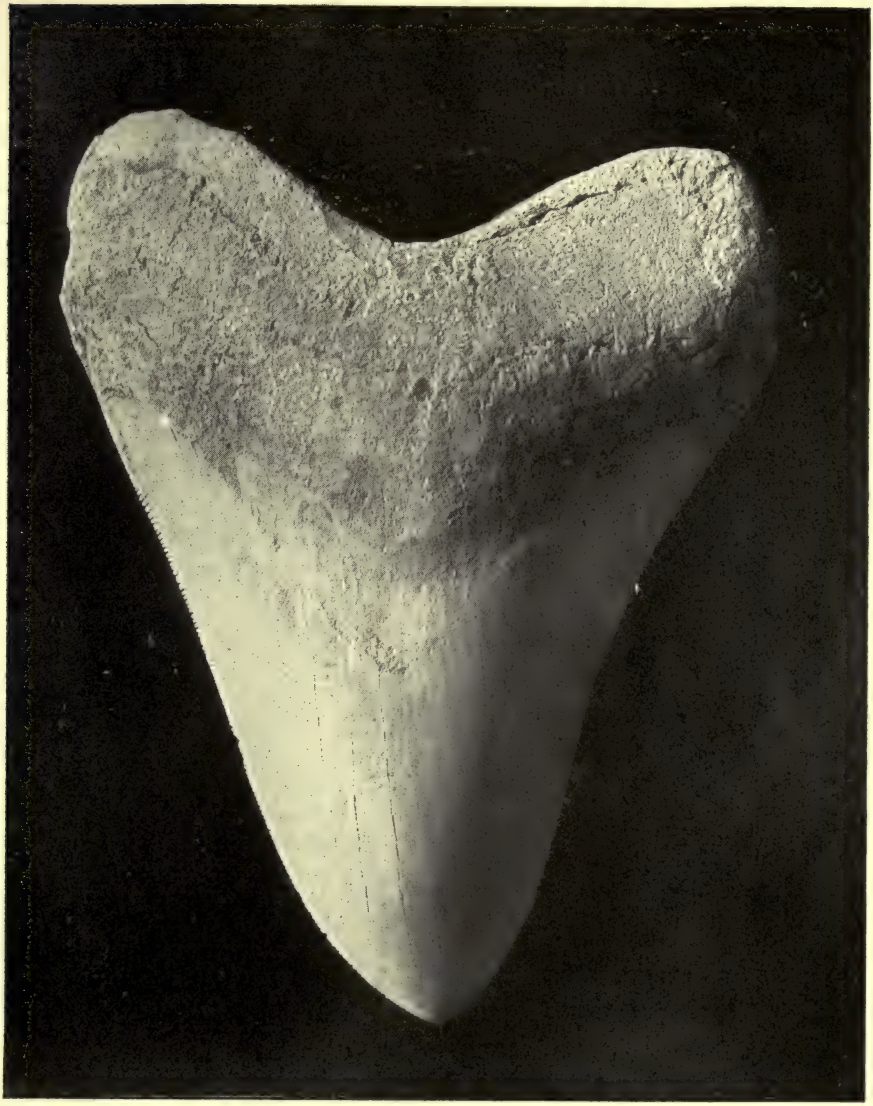
The public lands at present withdrawn on account of their valuable phosphate deposits are as follows:

	Acres
Florida	2,400
Idaho	1,149,569
Utah	87,040
Wyoming	1,267,494

This season three Geological Survey parties are in the field studying the deposits and procuring data for further classification.

It may not be generally known that Florida yet contains a large amount of government land. The phosphate deposits of the State have been little studied geologically, but there are believed to be many large unknown beds. At any rate, 2,400 acres of government phosphate lands in the State were withdrawn in May, 1910, and other areas are to be withdrawn. This checks the export game from the major portion of the phosphate fields, although the international fertilizer trust and other companies are understood to be in the market for any good phosphate land.

Following the first withdrawal of the phosphate lands in the West, the director of the Geological Survey was called upon to explain to the Public Lands Committee of the House of Representatives why he recommended this withdrawal. A number of lawyers who were present at the hearing representing western interests criticized and protested against such government interference with the development of the West, and were emphatic in their statements that the phosphate deposits of the world were practically inexhaustible. They cited accounts of phosphate discoveries in the South Sea islands and other sections of the world, and characterized the phosphate conservation movement as an absurdity. Director Smith replied to the effect that there had been some questions raised as to the legality or constitutionality of attempting to limit exportation of phosphate rock. He stated that he would hesitate to express an opinion upon such a matter as being outside of the scope of his activities; but when it came, he said, to lawyers invading the field of geology and present-



PURE "PHOSPHATE ROCK"

A prehistoric shark's tooth, natural size, found in Florida phosphate mine. Millions of such teeth, large and small, are shoveled out by the big mining dredges

ing off-hand statements as to unlimited supplies of a mineral and inexhaustibility of deposits, he felt called upon as a geologist to challenge such statements. By training the geologist was better fitted to see deeper into the ground than a lawyer could, and to estimate farther ahead in the matter of mineral deposits or supplies.

In this discussion the western attorneys denied that there was any intention of securing these lands for the purpose of exporting phosphate. It appears, however, at the very time that Director Smith

was making his statement the Geological Survey received a communication from the German consul at Atlanta, Georgia, stating that he had seen the notice of withdrawal of public phosphate lands, and that, as it was of the greatest interest to the German importers of phosphate rock to know to what extent they might depend on the output and exportation of phosphate rock in the United States, he requested such publications as might pertain to the subject. "It would especially interest me to know," he wrote, "the exact extent of the areas containing phosphate rock, and to be informed which of such lands are owned by the United States and by different individuals, States, and private companies." It will appear from this that the foreign fertilizer interests did in fact have their eyes turned toward these western fields for exploitation following the exhaustion of the eastern deposits.

As little is known by the great majority of farmers on the subject of fertilizer as perhaps any vital problem which confronts them; and many a man applies expensive nitrogen and potash to land which needs only phosphorus.

The Ohio Agricultural Experiment Station, in a long series of experiments with crops of corn, oats, wheat, clover, and timothy, has shown that every dollar invested in phosphorus paid back $4.76 under conditions in which neither nitrogen nor potash paid back their cost. The same station has found as the average of 56 tests in 11 years' work that when rock phosphate was applied in connection with manure every dollar invested in phosphate paid back $5.68.

Other interesting experiments have shown that raw phosphate rock, ground very fine and applied directly to the land without chemical treatment, is in most cases far more beneficial than what is known as acid-phosphate or phosphate rock dissolved with sulphuric acid. Until recently it had been assumed that, unless so dissolved and made "available" for the plant's use, phosphate rock was of no value as a fertilizer. It is now known that for use on all but very thin or impoverished lands raw phosphate will produce equal if not greater crops than the dissolved phosphate, while the sulphuric acid treatment approximately doubles the cost per ton of the phosphate and the fertilizing value is only about one-half. As a permanent improver of soils the untreated rock has much greater efficiency.

In dozens of State and Federal experiments the great increase in crop yield on almost all soils through the use of phosphate has been clearly proven.

Our first phosphate mining began in South Carolina in 1868. That State has since mined 12,000,000 tons, but her supply is largely exhausted. Florida came forward in 1888 as a great phosphate field, and she has produced 15,850,000 tons and is now the greatest producing State. In 1908 her output was 1,692,102 tons, valued at $8,500,000.

Tennessee phosphates were discovered in 1892, and this field became the greatest then known. About 5,800,000 tons have thus far been produced and the development of the field is yet in its infancy. However, considered as the sole source of supply, at the present rate of increase in national production the Tennessee phosphates would last only 11 years.

Arkansas next entered the field as a phosphate producer, but the rock is low grade and the output is small. Then came the discovery, a few years ago, of the great phosphate field of Wyoming, Utah, and Idaho, and it is in this and in the public phosphate lands of Florida that lies the hope of the American farm. On the basis of a rough reconnaissance three years since the United States Geological Survey estimated the tonnage of this western field at 63,000,000 tons, but further field work has shown this to be much too low. It is to be hoped, and it is the belief of the writer, that the detailed geologic investigation of this large field now in progress will show this figure several times multiplied.

Pending the proposed legislation by Congress, the known government phosphate lands remain safely tied up by the executive branch of the government,

while additional areas may be expected to be withdrawn as fast as they are found to contain phosphate. The proposed legislation is comprehensive, and, if Congress has in mind the future cost of living, the export restriction will include all public phosphate land in the United States now known or later discovered.

The geologic age during which the western phosphates were laid down was one of immeasurable importance to man, who, millions of years afterwards, was to appear upon the earth—the Carboniferous Age—that of coal and other useful minerals. This period followed the one when the Rocky Mountain backbone of the continent was beginning to push its way upward, and when a large portion of North America was covered by the shallow, primal ocean. The western phosphate beds were deposited by the washing down of the remains of myriads of minute animals on to what was then a shallow ocean bottom. The climate of the region was almost tropical, producing gigantic ferns, palms, and huge trees, but the animal life which contributed to the priceless phosphate deposits constituted a very low order. The giant reptilia, the great dinosaurs and plesiosaurs and other huge creatures came later.

The statement has been made by more than one person that this whole fertility-of-soils question is a false alarm. Why should our lands become so soon deficient in phosphorus when the soils of older countries have been farmed for centuries without extensive phosphate applications? The answer is that, in addition to shipping abroad great quantities of raw farm products containing thousands of tons of phosphorus, we waste. The Old World has learned to save and utilize sewage and various by-products which we destroy. American farmers have burned up millions of tons of straw and cornstalks containing large amounts of plant food. Dr. Van Hise, of Wisconsin, estimates an annual waste through the sewage of only the larger cities of the United States of the equivalent of 1,200,000 tons of phosphate rock. The total of the waste of phosphorus, potash, and nitrogen through exposure (see page 788) and other loss in the careless and ignorant handling of farm manure has been stated at between $50,000,000 and $100,000,000 annually. Until America learns, therefore, to avoid waste to a much greater extent than at present, there will be need for the application to the soil of much nitrogen, potash, and phosphorus.

And the greatest of these is phosphorus.

CURIOUS AND CHARACTERISTIC CUSTOMS OF CHINA

By Kenneth F. Junor, M. D.

NOTHING so profoundly impresses the traveler in China as her complete reversal of the greater number of our manners and customs. This fact is everywhere and every day evident.

The world generally believes the Chinese to have been always a stagnant nation, which is a great mistake. Changes in the fundamental form and character of the government have swept over China at frequent intervals with an intensity amounting almost to revolution.

Down through all the ages, from 1500 B. C. till today, certain forces run through her history like golden cords binding this great people into almost eternal solidarity. Among these are:

1. Belief in an omnipotent force—not always a person.

2. The deep sense of retribution, inevitable for all men.

3. Reverence, often changing its object, but ever there.

4. The sense of filial obligation, never diminishing, and extending even to the unseen personalities.

These are great forces in life—individual and national—and in no land are they so powerful or so all-pervading as in China. No people are more potently influenced by the unseen world.

Chinese civilization is one of the oldest on earth, and the only one which has continued uninterruptedly and vigorous till the present day. That it is vigorous is strongly impressed upon the man who travels far in that land. The reach of imperial authority is a constant subject of surprise and wonder. The card of an imperial prince, given to a traveler, will convey him safely and unmolested and secure for him courteous treatment to the remotest borders of the land: and yet China, unlike Japan, has never been under the domination of an aristocracy. The strength of certain governmental forces, under apparently disjointed conditions, is to the bewildered traveler as pleasing as it is surprising.

He finds relays of guards ready to receive him from the hands of one official and to convey him to the safe conduct of the next, and that frequently among peoples who have no knowledge of each other's speech and through officials utterly unknown to each other.

All officials, the binding links of this great government, come first from all the provinces, through their ancient system of civil service examinations, held in every great city. Finally they reach Peking, the capital, to be there fully equipped for government service and then sent back to represent and exercise imperial authority over the whole empire.

This civilization is unique and exceedingly difficult to understand. It is in some particulars so fixed and apparently impracticable, and in others so flexible and even loose, that it seems a mass of contradictions.

THE FORM OF GOVERNMENT

The form of the government is an imperial democracy. The imperial authority is absolute, but only within the law. The right of the people to revolt and dethrone the sovereign is most tenaciously maintained, notwithstanding the fact of the sacredness of his person in his being the ecclesiastical as well as the civil head of the nation.

The imperial censors, a department of the government, have been known to call down the Emperor, when acting illegally, as inflexibly as they would the humblest official. A censor, in fact, has been known to do this, and then take his own life at his sovereign's feet.

"The divine right of kings" has never had a place in China's polity as it was understood in Europe. Democracy is most plainly manifest in her municipal organization and administration.

This is the land whose cities have no lights, no plan, no sewers, and no sidewalks. Her people have no public spirit, no patriotism, no idlers, no national feeling, and no secrets. The splendid monuments of one dynasty are almost invariably destroyed by its successor. A deeply religious people, yet, according to their proverbs, priests and temples are a curse.

Notwithstanding all these anomalies, every province, every city, every hamlet is districted, and in the hamlets some respected citizen is recognized as head man. He is held responsible for its good conduct. If any crime is committed he is held till the culprit is found. In a land where there are few secrets, and where these head men are very close to the people, the guilty seldom escape. Numberless cases of social trouble and dispute are, through this arrangement, never brought to the courts, but are settled among themselves. This paper, of course, records the conditions only among those Chinese who have come little in contact with foreigners and who constitute the vast majority of the nation; whose heroes are pictured sitting on their halos instead of wearing them.

Her millions amply testify to ages of untiring energy in her stupendous public works, her myriad walled cities, her great wall, 1,500 miles in length and from 20 to 25 feet both in thickness and height, climbing the mountains and span-

Bargaining for gold and silver shoes (ingots) made of paper for use in temple worship and at funerals: Peking, North China

Photos from Rev. B. St. John

RAG-PICKERS IN PEKING, NORTH CHINA

ning the rivers, being in many important passes double-built 2,000 years ago. What nation can match it?

Her canals surpass those of any nation in history in their extent, and here is found the longest canal in the world. It was built at the dawn of the Christian era, and is 800 miles in length.

Think of her hundreds of cities which are circled by mighty walls, some of them from 40 to 50 feet in both height and thickness, and the human labor expended in their erection.

Ethics, conduct, personal and official, the principles of government and religion have all been discussed, ably and even exhaustively, by the scholars of China in public and in books; first by Confucius and Mentius, 600 years before the time of Christ, and since through succeeding ages by many thousands of less celebrated but able writers.

THE LITERATURE OF CHINA

One of the most remarkable literary sights in the world can be seen at Hsi-Si, the seat of an ancient university, where are 320 massive stone columns on which, through the ages, have been inscribed the names of more than 60,000 of China's highest graduates. The writings of this literary host constitute a splendid body of literature of millions of printed volumes, for China had books ages before the West knew printing.

The time of Confucius and Mentius was China's golden age. The influence of their writings surpasses anything in any language. Every Chinese student, every official for 2,500 years, has studied them as classics. They have memorized the sayings, thought the thoughts, and, more or less closely, followed the example of these great sages.

Think for a moment of a great people through 25 centuries forever harking back to these remote ages and these truly great men. Who can measure the influence, even of this attitude itself, under such conditions, and who the influence of writings whose power has been acknowledged by millions through 2,000 years? No wonder it has made them a peculiar people, intensely conservative and exhibiting a civilization which is a complete reversal of our own, which is the development of an opposite experience and purpose, namely, looking toward the future.

Many a Chinese emperor has sought to break the power and force of this literature, feeling it to be a millstone about the neck of despotism. One of the greatest of the emperors, the one under whom in 230 B. C. the Great Wall was built, ordered all the great writings to be consumed to ashes, and this was done. But the great scholars who had them stored in their memories rewrote them, and, to secure them against any second destruction, in 170 B. C., had them engraved upon 170 slabs of granite, which remain to this day. From these tablets, by a happy accident, the art of printing was discovered. A damp paper having been one day laid upon their face, the impression was noted and the discovery made about 650 A. D.

The scholars today rule China. Where dress is of more moment than in any country, yet the scholar, though poor and meanly dressed, is received with honor by the highest in the land.

"The superior man" of the classics is the equivalent of the *"good man"* with us. This man, his character and his conduct, is their constant theme. His virtue, his honor, his social relations, his manners in public and private are carefully defined. His dignity is among his highest qualities and must be maintained at any cost. Ceremony, with a capital "C," is his life. So deeply has ceremony burrowed into his character that it not only reaches the absurd but approaches the tragic, since it must be maintained, even at the expense of truth.

The very character in which the classics are written is worshiped. Literary societies all over the empire send out men who collect every piece of paper, every bit of wood or crockery on which is written or printed a character. These are all consumed to ashes in bronze urns at the Confucian Temple, and are then carefully boxed and carried in procession,

WOMEN WOOD-CARRIERS

THRESHING BEANS

followed by all the officials in their official robes, and cast into the water as an offering to the god of literature.

THE DIGNITY OF CORRESPONDENCE

While we construct our sentences to make our meaning clear, the Chinese love to conceal the meaning, only giving you a clue by which you may discover it. In epistolary correspondence they are absurdly ornate and stilted. For example, a Chinaman, on receiving word of the death of his parent or relative, will call upon some one, perhaps a young lad, to procure a stereotyped letter from a copybook, one suited to the social standing of the deceased, tell him to copy it, and send it off for him. It must be in good form in any case. Official documents, on the contrary, are terse and to the point.

The reason for this strange reversal is this: Correspondence is common and is therefore likely to become careless and vulgar in style. Official documents are not exposed to this danger; therefore the dignity of the endangered style must be sustained. The claims of affection give way before it. The character of an official document will sustain its own dignity.

The "superior man" never calls a spade a spade, as with us. A "sheet of paper" is a "flowery scroll" because of its possibilities. "Husband and wife" are "tenor and treble" because of their verbal relations. "A genius doing drudgery" is a "race-horse to a salt wagon." The prettiest street in Canton is called "Street of Refreshing Breezes," etc.

The boy in school turns his back upon his teacher when reciting, to show his humility and respect in the presence of the scholar. There is also the practical reason that he is thus unable to gain any help from the teacher's expression of face.

The Chinese read from above downward and from right to left. Books are printed on only one side of the page, and the page is a double sheet. The language has no grammar. A school is a bedlam of noise, because each child recites constantly at the top of his voice.

RELATIVE POSITION OF THE SEXES

The position of woman is degraded, but it has become so as an additional attempt to exalt and sustain the superior man. On entering a room he precedes her, and she stands up to address him.

The superior man rarely hurries or exerts himself, because by so doing he risks his dignity. He would be utterly ashamed if anybody caught him jumping a ditch, for example. The superior man must be carried over in a chair or on the back of a coolie. He is horrified at his wife, or, in fact, any woman, doing any undignified thing, such as playing lawn tennis, because, though she is inferior, yet her dignity touches the dignity of her lord.

The character, however, of this superior man has in practical life sadly deteriorated. Through ceremony the soul has practically departed from his conduct and the ceremonial body alone is left. Thieving and lying are too frequently considered as less culpable than the indignity of being caught.

A Chinaman mounts a horse from the right side, and with the right foot, and holds the reins in the right hand—all because he can more easily and safely maintain his dignity, in the doing of these things, by using the stronger hand. When mounted he rides slowly and sedately; never more than at a walk. He stands his horse in the stable with his face outward, because it is more dignified to approach a beast to his face.

If he meets you on the street in undress he will probably pass you without saluting, but later he will return, fully dressed, to confer upon you the proper offices of politeness. Time and trouble are no object in the case. This is his idea of honoring and sustaining the dignity of the superior man in himself and you.

THE ETIQUETTE OF THE TABLE

The guest of honor is placed on the left in China, because in this position alone can the host gracefully and in a dignified manner perform towards him those ceremonial offices of propriety re-

quired on such occasions. In that position he can pick out with his chop-sticks any little tidbit, and either place it on the table before his guest or place it directly in his guest's mouth. If his guest were on his right side this could not be done.

The guest is compelled, by propriety, fairly to gorge himself at a banquet in order to show his appreciation of the feast. He must leave nothing on his plate. He will eructate into his host's face to show his relish of the viands. On entering and leaving, host and guest will keep up the "Gaston and Alphonse" act to weariness, vying with each other as to who shall be the last to pay the offices of politeness.

If his tea or soup should grow cold he will make a great noise with his lips in drinking it, to give the impression that it is hot, so that his host may not be charged, even by implication, with any neglect of hospitality. Tea might be called the formal social glass in China, but the real treat at the meeting of friends in a social chat is pumpkin seeds. Water is never drunk cold, but hot.

Men and women do not eat together, but the employer will eat freely with his employees at the table. By eating with women the dignity of the superior man would be sacrificed. At a wedding the groom is the center of interest. The bride is noticed only as a matter of curiosity. Her feet are of the first interest, because a woman's beauty, to the Chinaman, is in her feet, not in her face.

THE ORIENT VERSUS THE OCCIDENT

The scholar never pares his nails. He never works save with his pencil, and, as he has little use for the left hand, he loves to cultivate long nails on that hand. Scholars with nails ten or twelve inches long are seen. The nails of the Dowager Empress were from four to six inches in length and protected by jade and gold thimbles.

The Chinaman, when puzzled, scratches his foot instead of his head. Many other instances of reversals of western customs can be given, the reasons for which, however, are not so easily discoverable. They are due to custom and environment. Their beds have no mattresses and their furniture no upholstery, but the carving and inlaying are beautiful. Their pillows are hard blocks of wood or little boxes in which the traveler carries his toilet articles and money. They have no stoves, and, in many sections, to keep warm at night the beds are the tops of brick ovens. Where there are no ovens they simply pile garment on garment till they are so solid with clothes they can hardly move. They carry in the hand little stoves in the shape of baskets containing charcoal.

The women wear pants, while the men wear long gowns down to their feet. The vest is worn outside the coat and the soles of their shoes are white and not black.

Although woman is so despised, she has two weapons which give her incalculable power. One is her tongue, regarding which their proverbs are extremely eloquent. The other is her threat of suicide. By this threat a Chinaman is scared into giving his wife anything she desires. We designate our criminals by numbers, but the Chinese so designate their wives as number one and number two wife.

They locate intelligence in the stomach. Their surgeons are outside doctors; their physicians are inside doctors. If a patient were shot by an arrow, for example, the surgeon would break off the pieces outside and the physician would extract the remainder embedded in the flesh. They pay their doctors to keep them well, and punish them, if they can, if they get worse or die. A doctor's fee is called "horse money," because the physician's office is a degraded one. No dissections or amputations can be performed, because the body must pass into the spirit world unmutilated. If the surgeon proposed amputation he would probably be asked how much he would be willing to pay for the privilege.

DELICACIES OF THE TABLE

Fruit left to ripen is considered unwholesome as being too near to decay,

and yet they eat things a thousand times more dangerous. They eat the beaks of birds, the fins and brains of fishes, the entrails of animals, and consider that the claws of tigers, boiled to a jelly, impart strength. The flesh of snakes gives cunning.

Eggs are appreciated according to their age. Those 100 years old, black with age from being preserved in ashes, are great dainties but not uncommon.

Husband and wife are betrothed in infancy. The intended bride comes to his home and becomes a servant to her mother-in-law as long as she lives. No separate family is set up on a son's marriage; simply another addition is made to the house. Thus there are little villages, consisting of a single family, scattered all over China. Some have reached the dignity of cities of a single clan.

Pawnshops are in rich, not in poor neighborhoods, and are only patronized by the well-to-do.

With robbers and beggars they have regular contracts, and the night watchman goes round your house beating at intervals a hollow bamboo to inform the thieves of his whereabouts and at the same time prevents your sleeping, so that *you* may be ready to repulse the thief if he should attack. It is a pretty theory for comfort, surely.

In mathematics their decimal fractions are our vulgar fractions and vice versa. Their denominator is our numerator, etc.

They row a boat standing up, facing the bow, and haul the boat on shore by the stern instead of the bow. They tow by the masthead instead of the bow. There are excellent reasons for these reversals. The Chinaman says we were not given eyes in the back of the head and should see, certainly, where we are going, which our method prevents us from doing. They always write Smith John, and date a letter by the year, the month, and the day, and in these customs they are decidedly right.

THE MARINER'S COMPASS A CHINESE DISCOVERY

The mariner's compass was discovered by them 1100 B. C., and was first used on land. The needle points to the south. Chariots equipped with it were called "south-pointing chariots." Contrary to our mode of expression, they say west-south and east-north.

In contradiction to their own ideas of dignity, however, "the superior man" will play battledore and shuttlecock with his feet and fly kites, while the boys, like old men, stand sedately by and look on. This he does as a method of instruction, and to show the children how the superior man can relax when the high purpose is to entertain and educate the young.

The woman in sewing pushes the needle from her, while the carpenter draws his plane and saw toward him in working, the teeth of their saw being set in the reverse order of ours. Money is divided by weight, and consequently the Mexican silver dollars, which are current, are chopped into bits and handed out as change. They have only one national coin, the "cash," which is of varying value, from one-sixth to one-tenth of a cent.

Vegetables, eggs, wood, etc., are sold by weight. In this they are far in advance of our absurd and unjust custom.

Men only have the honor of a funeral granted to them; women, having no souls, are not of sufficient importance. Their mourning color is white. Mourners at a funeral are all hired.

The traveler has constant and annoying experiences of the proverb, "Hope deferred maketh the heart sick." Meeting a fellow-traveler and asking him how far it may be to the next village, he will be told, "Oh, only 6 li." After traveling what he feels must be nearly that and inquiring again, he finds it is now 8 li. The simple explanation is that each traveler estimates distance, not by measurement, but by the difficulties of the road.

In some sections even the axles of their carts are fixed in the wheels and revolve on the body. They can be heard a mile away.

To the Chinaman the foreigner is a boor and a barbarian. It seems a hopeless task to teach him politeness. He

PAINTING THE WARE
In this art children soon become expert

POUNDING RICE
Preparing rice by pounding with a heavy stone

looks upon us as creatures of yesterday. To him China is the Middle Kingdom—not only the center, but the major part of the earth. I once saw a Chinese map of the world; it was three feet square and had a rim all around the edge one inch wide which was marked as the place of the outer barbarians; the rest was the "Middle Kingdom."

The Chinaman wonders why the foreigner leaves his country at all. Is it too small for him to make his living, or has he come to observe the superior people? If so, he is to be commended. But, alas! what a boor he is. What tight and uncomfortable clothes he wears, like the skins of beasts. How vulgarly he eats, and especially what quantities of flesh he devours. No wonder he is blood-thirsty and loves to fight—he has taken on the disposition of the beast. During the Boxer trouble, in the traveling Punch and Judy shows used to stir the people all foreigners were represented on the stage by the figure of a pig. Although fully convinced of our cleverness, he yet looks upon us as we do upon a trick dog. He is finally forced to the conclusion that he must adopt these methods which have made the foreigners so powerful.

THE HIGHEST HONORS ACCORDED THE SCHOLAR

It is difficult for us to understand the amazing hold of these ideas upon the Chinese mind. It begins in the village school. The boy ready to become a scholar is dressed like a Mandarin for his first day; elaborate preparations and ceremonies impress his young mind. His father accompanies him to school, where he bows to the ground before the tablet of Confucius and then before the teacher.

Only a Chinaman can appreciate the permanent uplift the boy receives from the consciousness of his having now entered upon the quest of scholarship. That first impression never fades. That this impression is phenomenally deep, not only on him but on all the people, is manifest by the high honor paid to the scholar.

When the student who succeeds in passing his first examination returns home, every one in his village and neighborhood turns out, dressed in holiday attire, to honor him. Everybody brings him a present and officials come in official robes to congratulate his parents. His household is privileged to erect two tall poles before the door and place a tablet over it stating this to be the home of a scholar.

But the real depth of the seriousness with which the Chinese regard scholarship is shown in the remarkable fact that for five long years, from sunrise to sunset, this school-boy will pursue, under the most discouraging conditions, the study of reading and writing characters, without knowing the meaning of a single one. It is an awful grind, which no human being could sustain save under the most powerful stimulus. That stimulus is the hope of being a scholar and an official.

ANCESTRAL WORSHIP AND THE FEAR OF DEVILS

What passes for religion is simply a conglomerate of ancestral worship or filial piety, mixed with Buddhism and Taoism. Translated into actual life, it is superstition of the grossest and most ridiculous kind. It controls every Chinaman and in almost every portion of his life from birth to death.

It may be truly said that the influence of the dead upon the living is even greater than all other influences combined.

Undoubtedly the early religion of the Chinese was the worship of the true God, the Siong-Te of the present day. That worship is represented by the Temple of Heaven in Peking. There the Emperor, a solitary figure, but surrounded by an imposing retinue of princes and high officials, and as the representative of his people, appears once a year to offer up a whole and unblemished bullock as a burnt offering. On the central stone of a magnificent terraced platform of marble 250 feet in diameter and three stories high, he kneels to offer prayer for his people. No subject is permitted to take part in this solemn act of worship.

The Emperor worships no idols, but makes and unmakes the other gods at will. His is the worship of heaven and means that his imperial authority is derived from heaven and is responsible to heaven. For 4,000 years this solemn act has been performed by each succeeding emperor. When the imperial family fled at the close of the late Boxer trouble and foreign troops entered the city of Peking, the sad spectacle was seen of this sacred edifice, sanctified by the worship of four millenniums (not of course at this very spot), turned into a barracks. Thus were the feelings of China wantonly outraged, and yet people wonder why they so bitterly hate us.

The common people are terrorized by a superstitious belief in devils.

The ordinary Chinaman knows nothing of religious distinctions. His religion is practically an elaborate system of devil worship.

All their gods are deified historical characters. Practically they have no idea of a heaven as we understand it. There is simply a place of spirits without any definite character. Buddhism, of course, describes the tortures of its hell, but Buddhism is only a part of the religion of China.

Rich men by large gifts of money have become the gods the Chinese worship. There are now being erected five new temples to Li Hung Chang, the great modern statesman, who is said to have paid one million dollars for the honor of being a god. Those who have money or property use it more or less lavishly, according to their fears in propitiatory rites, to these gods for favors desired or to purchase freedom from calamity. The Chinese spend yearly untold millions on these rites. It is from these wasteful practices, more than from any other causes, that the miseries of the Chinese come. Their terrors drive them into unparalleled distress. Chinese religious rites cause absolute waste, because millions of property are consumed to ashes in their observance. Until the cruel bands of this devil-worship are broken, China cannot become a great nation. Without money no one has any religious standing. His spirit cannot even reach the spirit world, but becomes a wandering ghost or devil.

They believe that every man has three spirits. These three spirits, in the case of Chinese who are properly cared for at death, have each a distinct place of residence. A fourth order of spirits also exists, consisting of the spirits of the uncared for and unburied dead. These latter are wandering spirits, ghosts, or devils.

The first of these spirits, when a man dies, goes into the spirit world. Once a year all such spirits are liberated for a month to revisit their old homes. During this month tables covered with viands of every description are placed on the street before the door. It is hoped that these spirits, seeing this provision, may be induced to bring prosperity to the family. They believe these spirits partake of the viands.

THE LOGIC OF THE CHINAMAN AND HIS SPIRIT ZONE

A shrewd Chinaman, asked as to this by a foreigner, replied, "Well, I imagine our dead can as easily eat these things as yours can smell the flowers you provide for them."

A spirit's comfort and condition are in exact proportion to the provison made for them by the living. Everything is passed over to the spirit world by fire. At death a ceremony called Hong Tek is observed. A platform, often of silk, is erected, stretched over bamboo poles so as to represent a Chinese homestead. Fields and streams, houses, soldiers, servants, domestic animals, implements, vegetables, grains, fruits, and so forth, all made in miniature, stock it. Before this unique structure, which often costs several thousand dollars, Taoist priests perform the proper ceremonies, lasting three days. The whole structure is then set on fire and passes over for the use and comfort of the dead.

The second spirit does not go into the spirit world, but takes up its residence in the bones. When the time for burial

THE SIMPLEST KIND OF SEDAN CHAIR

arrives, which may be months after death, a live fowl is carried before the coffin to convey the spirit to the grave, and paper representing money is scattered all along the road "to buy the way" from the devils or spirits of the unburied dead, who are everywhere. At the end of five years the body is taken up, the bones cleaned, and replaced in an earthen vessel. This is the proper burial.

Every year the relatives go to the grave to offer provision and pay reverence to this "grave spirit." This is why all Chinamen desire to be buried by their relatives and in China, else their spirits may become wandering devils. For the same reason they make every endeavor to have the bones of their relations transported to China if they die abroad. Prosperity and health are only secured to the survivors by the proper observance of these ceremonial offices.

To the third order of spirits belongs particularly ancestral worship. By elaborate ceremonies the third spirit is induced to enter what is called an ancestral tablet prepared by the family on the approach of death. This tablet is the sacred symbol of the ancient religion of China, which Confucius found existing in his day, 600 years before the time of Christ. This tablet, containing the spirit of the father, is set upon the principal table in the house or is sent to a Confucian temple. In either case all the family pay their devotions before it. This is ancestral worship or filial piety. The Chinese are also firm believers in the transmigration of souls.

The fourth order are the spirits of the unburied dead. They are those which have no friends, no graves, no tablet, and which have never been conducted to the place of spirits. They are an innumerable host, wandering spirits, ghosts, or devils. They are everywhere — in caves, in mountains, and in valleys. They wander through the country roads and in the city streets. They are in stones and trees and houses. They pass through the air only a few feet above the ground. For this reason houses in China are only

STUDENTS OF BOYS' SCHOOL, CHINA: HINGHUA CONFERENCE

permitted to be one or two stories high. Pagoda temples and pawnshops are exceptions by special permission and payment. Here is found largely the objection to railways, telegraphs, and the high houses of foreigners. These things bring actual terror to the Chinese, for they interfere with the flight of devils. Calamities of every kind hang over the neighborhood through these offended devils.

Spirits cannot turn a corner safely; hence all public highways and waterways and city streets are never built straight, but twist and turn. It is hoped by this arrangement that the devils may get confused and lost. For this reason doors and windows are not placed opposite each other, and outside windows are rare, to prevent devils entering. As many intricacies as possible are introduced. The very straightness, therefore, of railways and telegraph lines and all roads built by foreigners is a menace.

In the above conditions lies one of the great secret causes of hatred toward foreigners; for, though the Chinese may actually build these roads and houses for the sake of the money they earn, yet they do so in fear, unless they can find a satisfactory way of counteracting their malign influence. The hatred, however, always abides.

DRIVING OUT THE DEVILS

Taoist priests can buy or drive these devils out, and you find them beating tomtoms through the streets at that work at any hour of the day or night.

Boys, so precious to the Chinaman, are given girls' names or dressed in girls' clothes, or called dogs, cats, or any old wretched things to trick the devils into supposing they are not boys at all. The devils may then think it not worth their while to bring calamity upon them. They certainly have a very poor opinion of the intelligence of these devils.

No journey, no business or social engagement is undertaken without propitiating these spirits.

No grave is located by the astrologers till the proper ceremonies are performed and their permission secured for burial. These burial professors are sent for at death. They live with and must be kept by the family freely and be paid besides. It is their policy, therefore, to prolong their decision as long as possible. Sometimes months elapse before they decide, and in the meantime the body remains in the house coffined but unburied. So superstitious and fearful are the people that, although they are quite aware of the trick, yet they submit to the dreadful imposition.

Not so strange is it that among a people dominated by such beliefs a coffin should be among the best of gifts to a friend. The necessities of such burial rites explain also the fact of the traveling Chinaman carrying his coffin with him as part of his baggage. Coffins are, for evident reasons, made of great thickness, and are supposed to be air-tight. This is, unfortunately, not always the case. Visitors would welcome more careful sanitary conditions.

Shrines are met with everywhere and in the most extraordinary places. Where any bones are found of some one murdered or starved to death, there a shrine is erected and the bones collected and placed in it. There the traveler will pause and cast in a "*cash*" or place an incense stick to propitiate the devil of the deceased.

Property is not devised by will, but is apportioned before the father dies. No such outrage as the neglect of parents can occur in China as with us. Honors, if conferred, are bestowed upon ancestors and not upon descendants. It is a constant subject of wonder why Chinese homes are so often located in such insanitary situations. The cause lies in the same fear of devils. The owners imagine themselves more likely to be free from their visitations, as they think the devils may not consider it worth the trouble to look after such wretched people.

The very reverse is the case with their graves. These are the residences of their ancestors and nothing is too good for them. The beautiful breezy hillside

having the finest outlook is chosen. The tombs of the sages are in fine groves of beautiful cypress trees.

Temples receive far less attention than graves, and, as they depend on voluntary support, in the majority of instances are often allowed to fall to decay.

Priests in China are classified very low down in the social scale. The Chinese proverb states that "when the priest and temple come to town morals fade." Priests and their sons are not allowed to become scholars.

The son is the climax and supreme desire of the family, because only a son can render the proper service to the father's spirit. For this reason female children are not welcome and infanticide is frequent, but always of the living child, necessarily; otherwise a son might be slain.

WHAT MONEY WILL DO

The rich Chinaman, if condemned to death, easily procures a substitute. Some poor wretch without money to secure his spirits from becoming wandering devils, with the price of his miserable life can purchase proper care for his spirit. Anything, in fact, can be done if you have the money.

It is this belief that causes the Chinaman to commit suicide by taking his life on the premises of his enemy to take vengeance on him. His spirit, he believes, will forever haunt him. There is another reason also: he knows that as sure as fate the officials will under such circumstances come down upon his enemy and strip him of everything.

Poor Chinese have been known to sell everything they possessed, tear down their houses to sell the timber, sell or rent out their wives and children, and even sell themselves to procure money for the proper rites for the peace and comfort of the ancestral spirits. One thing alone he will not do, namely, sacrifice his son.

At the death-bed, where with us the hush of sorrow reigns and affection brings silence, the awful beating of drums, the crash of cymbals, and the tumult of fireworks hold carnival to frighten away the devils who are tormenting the dying and causing death.

China, rich and picturesque, with climatic conditions ranging from the Arctic to the Torrid Zone, has an unrivaled history of over 4,000 years. Her discoveries and accomplishments cover—

Arches in architecture, carving in wood and moulding in bronze and other metals, painting with unrivaled colors, printing, paper from wood pulp, the mariner's compass, gunpowder and guns, books, astronomy, public assembly codified laws, civil service examinations, bank notes and coins, and heating houses by hot-air pipes carried from a furnace. All of these she possessed centuries before they were dreamed of in the West.

Travelers find salt mines 2,000 feet deep, crudely sunk by two generations of laborers.

Her mighty rivers, some of them 3,500 miles in length, have been so connected by thousands of miles of artificial canals that this land is a perfect network of waterways.

Her economists saw stability and equality in a proper division of the land among the people, in making labor noble, and in taxing the owners of unproductive land. To this day the Emperor, with great ceremony once a year, with a golden-handled plow turns up a furrow of land to point to agriculture and give labor dignity.

Although China's government is an imperialism, yet the Chinese people have always acted in opposition to the maxim of the divine right of kings. They have held inflexibly through the centuries that every man has an inalienable right to free thought and speech. They have always tolerated any and every form of religion, so long as it did not interfere with or in any way imperil the authority of the state.

EXALTED IDEALS EMBODIED IN THEIR PROVERBS

No people are less riotous or more amenable to the voice of reason. A Chinese mob, more than any mob, can be influenced, subdued, and made ashamed by a reference to the teachings of their

fathers, producing in them such bad manners. When other people dressed in rude garments, they were clothed in splendidly colored silks of their own manufacture, colors which have never been excelled to this day.

A distinctly religious and keenly intellectual people, they have passionately loved harmony, and have shown themselves capable of high thinking and modest living.

Diligent, also, they are to the last degree. Men and women slave from sunrise to sunset. Even the Emperor himself will frequently hold audience with his ministers at 3 or 4 o'clock in the morning.

China's contact with the West during the last three centuries has been most unfortunate. On our part it has been coercion, attack, and grab. We have despised her people and disregarded her rights, while demanding her trade at the point of the sword. Her age, her thought, her isolation have made her conservative and proud. We have tried by force to hurry her, and by shot and shell have compelled her to open her gates. Degrading superstition has made her suspicious, and the struggle for bread has made her intensely material. Still her superstitions have kept before her eyes the unseen, and possibly have made her people really less materialistic than ourselves. The Chinese deny themselves far more for their religious beliefs than do we. We should not forget that our better knowledge of the unseen, our clearer apprehension of religious truth, came from the revelation of the Bible, the foundation on which our higher civilization is built. In its possession we have, as a race, little of which to boast. To us it is a legacy from another ancient people, the Jews. Peculiarities as strong and characteristics as great as those of that ancient people are among the valuable possessions of the Chinese.

If we seek their favor only for purpose of trade we shall make no advance in their friendship. The proverbs of their sages, familiar even to the lower classes of China, are full of warnings against precipitately encouraging that form of friendship. They are keen to discern motives, and appreciate high and noble ones in others, however much they seem to be lacking in themselves.

The lessons of China's history, unlike those of Egypt, Greece, and Rome, are not dead monuments, but living experiences in a great and living nation.

China, though sustained by her material resources for 4,000 years, has hardly touched her wealth. Living on the products of her own labor for 40 centuries, her riches are today almost intact and equal to our own. In this marvelous fact are to be found rich lessons for political and social economists.

BOOK REVIEWS

The Great Wall of China. By Dr William Edgar Geil. Pp. 390, 7 x 9 inches. 100 illustrations. New York: Sturgis & Walton Co. $5.00 *net.*

The account of this expedition through the heart of China, along the Great Wall from the Yellow Sea to Tibet, is most interesting and of great value. Particular attention has been given to illustrating this volume, not only to substantiate the text, but to make material additions to it, so that, in many instances instead of long detailed descriptions the photographs furnish the information without encumbering the work. Not only is there an interesting geographical, historical, and legendary description of this vast project, but Dr Geil has set forth from his wide knowledge of Chinese literature much that is to us new concerning the country and the people.

A Summer in Touraine. By Frederic Lees. Pp. 318, 6 x 8½ inches. 100 illustrations. 12 color plates. Chicago: McClurg & Co. 1909.

The banks of the Loire, Vienne, and Cher, those parts of central France richest in natural beauty as well as in historic memories, are here described as they appear to a leisurely traveler, who sees, as he passes along the river banks, and wanders through the old chateaux, the whole pageant of the Renaissance in France. Starting from the once royal city of Blois we visit the typical towns of older France, so rich in historic passages. Then at Tours we renew acquaintance with Balzac, and in the country around see the original settings of much of "The Human Comedy." Mr Lees, however, gives definite information for the present-day traveler who wishes to see the most of Touraine, as well as historic insight for the fireside traveler, who will find every notable chateau represented in Mr Lee's photographs.

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THE NATIONAL GEOGRAPHIC MAGAZINE

IMPRESSIONS AND SCENES OF MOZAMBIQUE

BY O. W. BARRETT

With Photographs by the Author

A COUNTRY as big as the Atlantic States from Florida to New York, with the capital near the southern boundary and half a dozen smaller towns scattered along the coast; more than 3,000,000 inhabitants, of which only about one per cent are whites; one of the oldest of all European possessions and one of the richest in agricultural possibilities, at least, but one of the least known countries in the world. Such is Mozambique.

Four or five good ports and as many bad ones; five towns and a small but up-to-date capital city, and a generous number of military posts and outposts, a few of which are in the real raw interior; millions of acres of the finest alluvial soil fairly aching to show the farmer what big crops may be grown; waterways like the Zambesi, the Limpopo, and plenty of smaller ones to allow cheap handling of products; no deserts, no salt sinks, no large swamps, no mountainous wastes, no impenetrable jungles; out of some twenty only one or two tribes that object seriously to paying taxes to the government, now that they realize that the tax collector is a vital organ of the white tribe, which objects to any one tribe exterminating another in the good old way; for, wicked as a bush policeman tries to be, he must needs fall far short of the unrestrained chief's "induna".

The early history of this strange section of East Africa should not be, even if it could be, written. We know the old-time black was as bad as a barbarian can be, and the endless tale of persistent, widespread, and continuous butchery would not be good to read.

Yet the ethnologist may well listen to the half legend, half true stories of the clans, tribes, and races that have been lost forever. No pottery, no carvings, no ruins will remain after a few more years; only language traces (for the slayers sometimes spared a few of the comeliest maidens) and father-to-son oral history. To ride over the site of a native village which probably held a thousand huts less than twenty years ago, to note the bits of charcoal, pieces of clay bowls, bones, and the few ominous breaks in the heavy ten-foot stockade fence made of hardwood logs set upright close together, forcibly reminds one of the wretched people, tired of fighting, who sought to gain respite by erecting a barrier that no foe could burn or climb over, only to

GRASS AND PALM-LEAF COSTUMES WORN BY THE NEWLY INITIATED BOYS IN A M'CHOPI CIRCUMCISION CAMP

This costume is the first one worn after the completion of the ceremonies which require a week or longer in the camp, and is said to be necessary to prevent the great danger which would result to all parties concerned should any woman happen to see the person of the new member. The striped pole with a rattle at the tip is in evidence beside the doorway of each hut, which is the temporary home of the boys during the initiatory period.

ANT-HEAP IN SISAL HEMP PLANTATION, MOZAMBIQUE

These termite nests are dangerous but necessary evils in the plantations. The cost of tearing down the heaps, sometimes 20 feet high, is greater than the damage the insects do to the crops. After the removal of the timber the colonies gradually starve to death.

KAFIR BOAT MADE FROM MIDRIBS OF PALM LEAVES BOUND TOGETHER: MOZAMBIQUE

Kafirs bringing maize from the hinterland to the Limpopo River for export. The women carry about 60 pounds at a trip; the journey requires from 2 to 6 days. They usually travel in parties of 3 to 10 or more.

Old Ronga (Kafir) woman with wooden mortar and pestle for husking rice, pounding maize, etc. Near Lourenco, Marques. Fish trap in background.

KAFIR CORN AS GROWN BY KAFIRS IN SOUTHERN MOZAMBIQUE

Height, about 15 feet; grown without fertilizers or "machine cultivation"; soil, 27 feet deep

perish some hot, red day amid the frightful "ooogh-sh!" cries of the enemy as their dripping assegaïs were thrust through and through the dying and dead.

The Zulus have had for centuries a superstitious fear of salt water, and so, when Chaka, Dingaan, and their brother fiends had devastated practically all the country between Zululand and Inhambane, wiping out kraals and even whole tribes by scores, they came to a long chain of lakes (the lower Inharrime) parallel with the coast, and there they stopped, thus saving one tribe of true, pure-blood Kafirs who had fled over onto the dunes and low, bushy hills between the "rosary" of brackish lagoons and the Indian Ocean. This tribe, the M'chopis, is the purest if not the only unmixed Kafir tribe now in existence.

HUSKY HAMMOCK CARRIERS: THE HAMMOCKS APPEAR IN THE BACKGROUND: MOZAMBIQUE

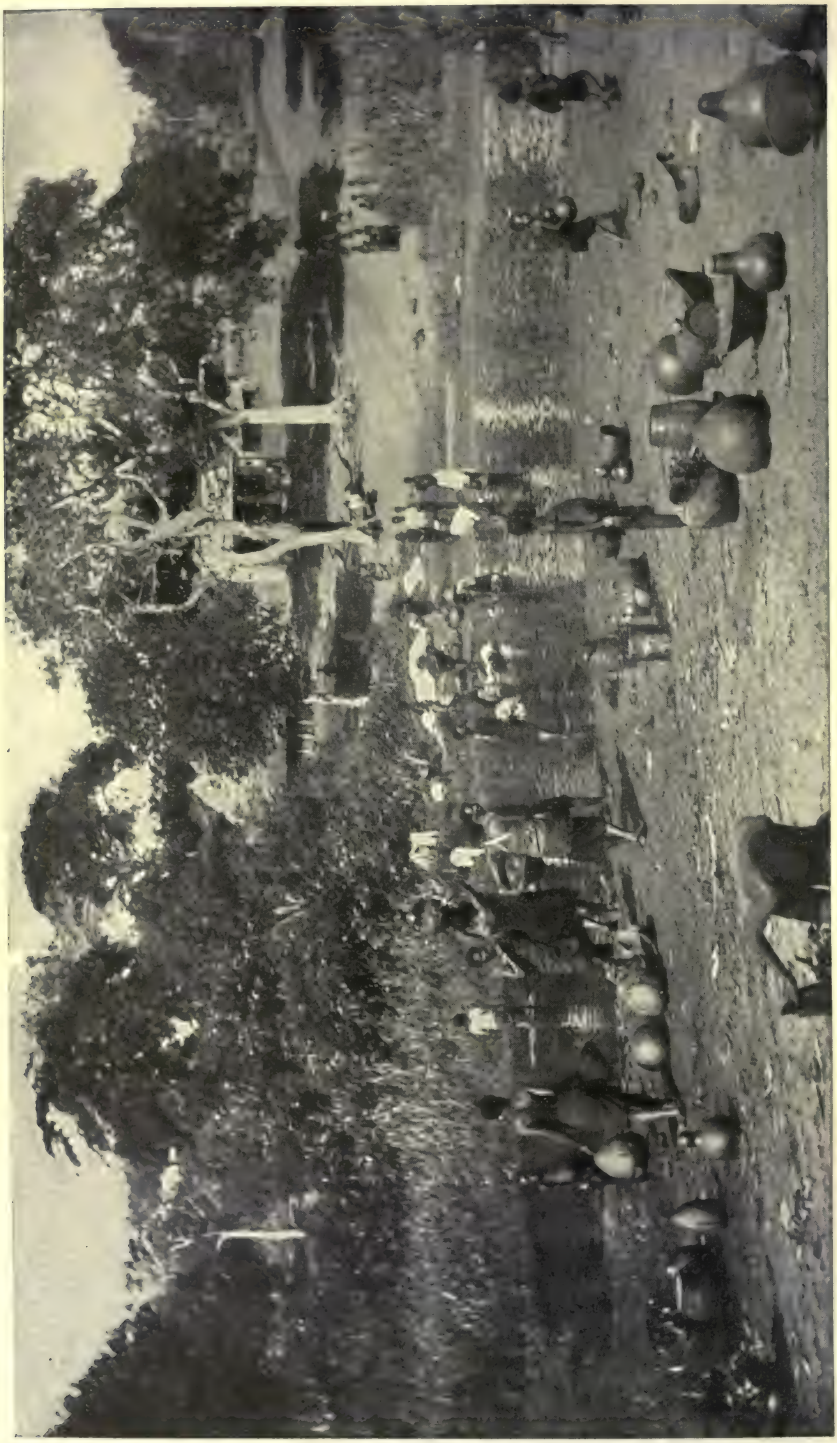
FORDING A BRANCH OF THE SLUGGISH, MIRY RIVER NEAR THE ZAMBESI

The "mashila" or hammock poles are raised from the shoulders to the heads of the carriers to avoid wetting the passenger. A lion devoured a native on the further bank shortly after our party had passed.

At Quesico we had the good fortune to witness a batuque, or ball, lasting nearly three days, at which about 3,000 fine specimens, mostly adults, were present. To describe the weird minor music of the marimbas, or huge xylophones, the blood-freezing death chants, the thrilling war songs, the "expression" dances of both women and men, and rites and divination ceremonies which the witch doctors were induced to show us would require much space. Many of these things could not have been seen by strange white men except that the commandante, Lieutenant Alves, the authority on all M'chopis [Mtyopi] matters, had the full confidence of the chiefs; and, besides, there were other more material inducements in the shape of feasts and presents.

At Inharrime, near Inhambane, we saw another grand batuque, with 3,500 Landims, M'chopis, and Bitongas. Here 200 native "pianos" kept up an incessant din for 36 hours. The "tunes" varied with the tribes. The Portuguese national air was executed pretty well by several of the bands, who had picked it up from obscure sources.

Each key of a marimba has suspended loosely beneath it a hollow gourd as a resonator. All but the smallest of these resonators have one or two apertures covered with the stretched membrane from a bat's wing. The membrane itself is protected by an artificial rim of wax, and this membrane continues to vibrate for several seconds after all sound from the key and resonator has disappeared. The particular orchestra shown on page 829 had learned to play the Portuguese national air very creditably, but when attempting "God Save the Queen" it became evident that the memory of each

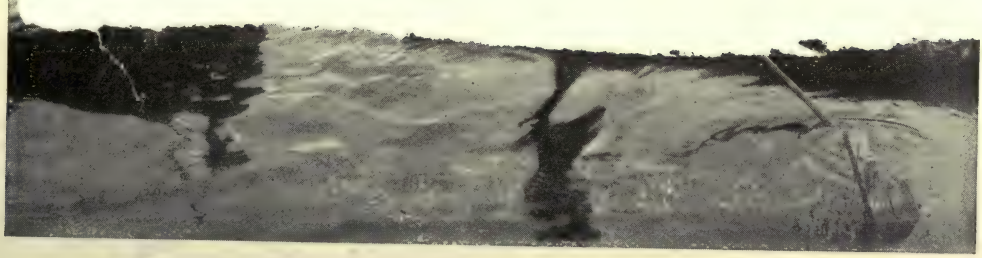


WASHING, BATHING, AND FILLING POTS AND GOURDS WITH DRINKING WATER SIMULTANEOUSLY: MOZAMBIQUE

INSIDE THE COMPOUND WALLS OF A COCOANUT ESTATE OF THE COMPAGNIE DU MADAL IN ZAMBESIA
Unhusked nuts by the hundred thousand are collected here to be opened; the "meat" dried into copra and shipped to Marseilles

KAFIRS OF THE RONGA TRIBE, UMBELUZI VALLEY, SOUTHERN MOZAMBIQUE
The ubiquitous 5-gallon kerosene tin is in evidence

RONGA KAFIRS: UMBELUZI



YOUNG KAFIR GIRLS, UMBELUZI: WORTH $25 TO $50 EACH: FILED TEETH RARE

NATIVE CANOES MADE OF BARK (BRACHYSTEGIA): MOZAMBIQUE

The section of bark is carefully removed from the tree, the ends folded in, and all seams and cracks caulked with native pitch

This custom is practiced by comparatively few members of this tribe and is undoubtedly in imitation of some of the tribes of Zambesia. The woman being usually right-handed, prefers to carry the child on the left hip, where it is not so much in the way while at work; hence the left breast is usually slightly elongated.

player was decidedly inadequate to the feat. All the notes from whatever style of marimba are in the minor scale. This form of musical instrument appears to be used only by the M'chopi tribe and their immediate neighbors, who are only poor imitators. The drum-stick carries a lump of native "landolthia".

The warriors in the dance, who may number 300 or more, constantly drop in their tracks and pretend to be smitten with death. The witch doctor then passes around, sprinkling them with medicine, whereupon all gradually resume their places and the dance continues. This dance is said to be as old as the tribe, which is probably the oldest Kafir tribe in East Africa. Their language is quite

KAFIR DRUMS AND RATTLES: THE ROAR OF THESE HUGE DRUMS CAN BE HEARD TEN MILES AWAY

distinguished from that of any neighboring Kafir tribe, and many of their customs are also peculiar. About 25,000 individuals are now in existence. They have the best "shambas" and take the most interest in agriculture of any known native tribe in East Africa.

The young girls' dance of the M'chopi tribe requires several years' practice before the difficult poses and contortions can be successfully performed. Several ankle rattles may be seen worn by the girls at the lower left of the picture on page 828. These hollow spheres are made of palm-leaf or grass, if not young gourd fruits, and are partially filled with large seeds, pebbles, etc. The noise of these ankle rattles is supposed to assist in keeping time in the dance. This is probably a Zulu custom, and even today in civilized Durban the ricksha boys frequently wear similar ornaments.

The tribes meet but do not mingle. Here we saw grave old M'kumbi, who has an income of $50,000 from the 10,000 huts of his tribe.

On the Zambesi, at the head of Chinde, I counted eight hippos at one time around the boat. Since the natives are not supposed to have guns of any sort, and since few devastating tourists pass that way, these uncouth monsters may endure a few years longer. There are usually to be seen one or two pairs in the Inkomati River, some three hours from Lourenço Marques, the capital. Feet a foot across and a body as wide as a wagon—no wonder the poor native sits up nights beside his corn-field when he hears the ominous "woo-uff" of an old tramp bull in the neighborhood.

Near Mopea, three days up the Zambesi, we passed through two small native kraals in which the lions had eaten 18 people in three months previous. It is quite impossible to hunt these man-eaters on account of the tall, rank grass (four to six feet high), and, since they soon

AN ORCHESTRA OF MARIMBAS: MANY VARIETIES OF THESE UNIQUE XYLOPHONES WITH HOLLOW GOURD SOUNDING BOARDS ARE USED

THE "MARIMBA" OF THE M'CHOPI TRIBE IN THE STATE OF INHAMBANE, PORTUGUESE EAST AFRICA

The resonators are made from a kind of wild gourd attached beneath the xylophone keys. One or two apertures in the side are covered with the membrane from a bat's wing, fixed with gum, so that a "snarling rattle" is produced, even continuing several seconds after the sound within has ceased. These gourds vary in size from 6 to 40 centimeters in diameter. All the notes are in the minor key.

learn that two or three cuffs will make a big hole in the side of an ordinary hut, the poor native must roost high or die.

Even Major Kirby, the famous lion hunter, has not been able, he tells me, to average one lion per month during his stay in the Boror Company's estates, where over 100 people were devoured last year.

In the Zambezia district there has been spent a large amount of money in agricultural experiments, and, though the results are not encouraging thus far, it is no fault of the land. I have never seen any soils quite so rich, apparently, in either temperate or tropical America as are to be found in the Zambesi, Limpopo, and Inkomati alluvial plains. The colonization laws are pronounced excellent, even by English colonials. They are automatic—just to the government, to the colonist, and to the natives. And here I may say that it seems to be agreed by men who know that nowhere else in Africa is the native question so well managed as in Mozambique. But it is a very big and deep and difficult question.

During our trips, covering some 250 miles on mules, 125 with hammocks, and 1,000 in boats, we came into touch with at least 500 natives as bearers and quasi-police guides; but not one thing was stolen during the ten weeks' travel, and never was it necessary to punish a "boy" for any misdeed. The 50 to 75 loads, 30 to 50 pounds each, were mostly pack-

HAND-DRUM ORCHESTRA OF THREE PLAYERS IN THE ZAMBESI DELTA

Both the bare hand and a short drumstick are used in producing the weird but highly variable "music." A carved image on a post presides over the occasion

WAR DANCE OF THE M'CHOPIS: FEIGNING DEATH TO BE REVIVED BY THE WITCH DOCTOR (SEE PAGE 818)

MASKS USED BY SOME OF THE WARRIOR DANCERS

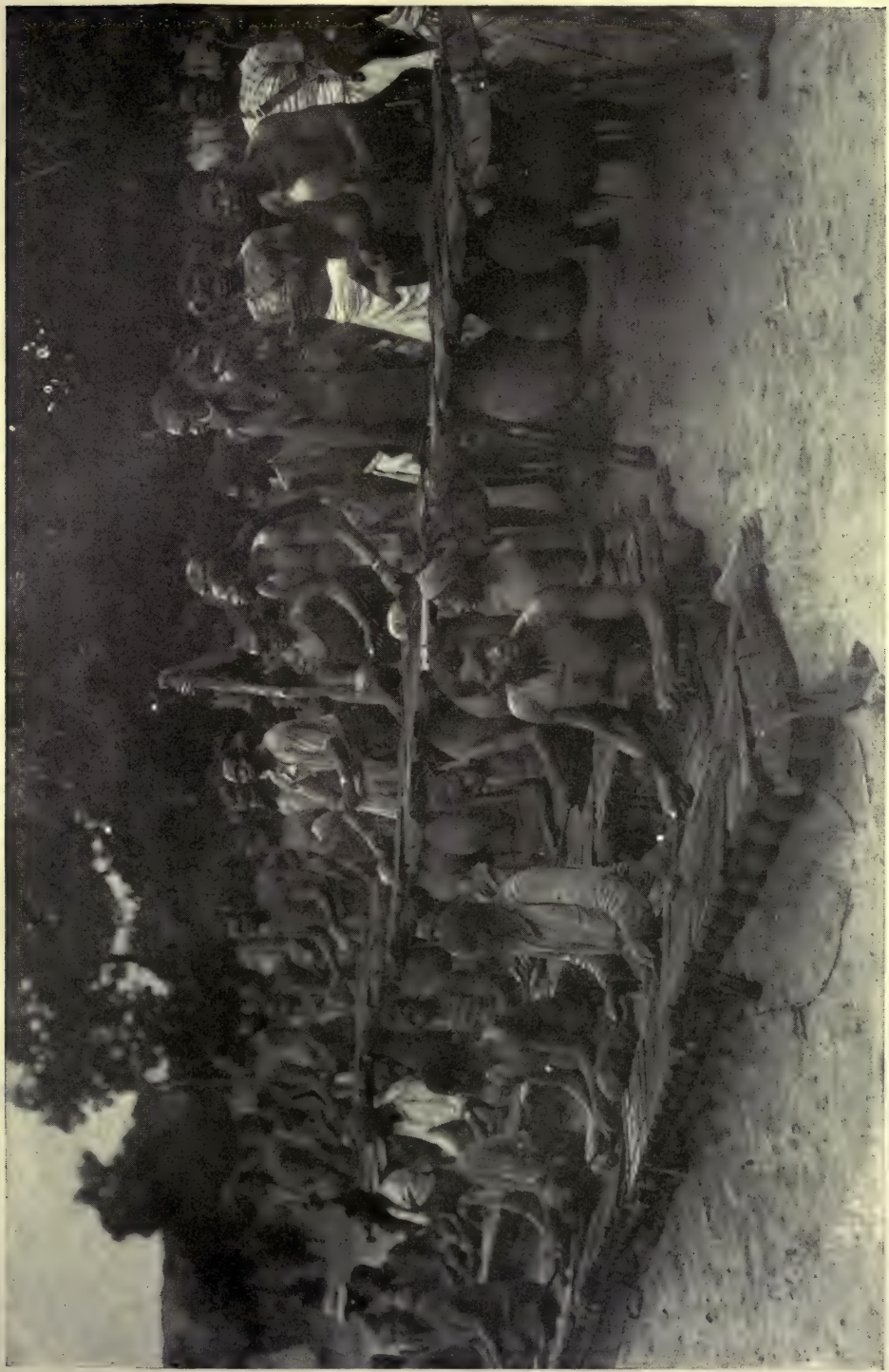
WOMEN'S WAR DANCE: QUESICO, MOZAMBIQUE: THE HEAD-DRESSES ARE OF OSTRICH FEATHERS

A WITCH DOCTOR

CEREMONIAL BOWS USED IN WAR DANCE BY THE M'CHOPI NATIVES OF SOUTHERN MOZAMBIQUE

The M'chopis are the oldest and yet the purest of all the Kafir tribes. They were saved from extermination by a saltish river, the Inharrime, across which no Zulu warrior would go, thinking it an arm of the (tabooed) sea

THE YOUNG GIRLS' DANCE OF THE M'CHOPIS
Note the rattles above the ankle of one of the girls (see page 819)



The din from this triple rank of marimbas was overwhelming. Only a small portion of the 200 "pianos" forming the orchestra can be seen

THE WOMEN'S WAR DANCE AT QUESICO, MOZAMBIQUE

ages filled with things dear to a native's heart and easily pilferable.

Neither were any acts of cruelty nor of indecency witnessed on the whole trip, except on the part of the whites. The farther away from civilized centers we went the more *respectable* became the native.

Thousands of "black ivory" specimens are exported to the gold and diamond mines of the Rand; they return with money, disease, discontent, and bad morals. The young men from Gazaland and Inhambane go on contract for say one year to get money to pay the hut taxes and to buy one or two wives. Instead of paying for a wife with cattle, as formerly, before the terrible ravages of rinderpest and "East Coast" fever, sterling gold, £10 to £25, must now be cashed down to the father before the union is legal or the bride enters the new hut.

With diseases which practically preclude the breeding of all domestic animals but the pig, it is no wonder that the rich lands are so very little cultivated. But the steam plow has put in its appearance and as soon as permanent regulations for sale or rental of land are promulgated the country should be a happy harvesting ground for planters. With labor at $2 to $5 per month, good transportation, no more sickness than in any other country, perhaps, and good support from the government, colonists will come and then Mozambique will gloriously come into her own.

THE LOST WEALTH OF THE KINGS OF MIDAS

By Ellsworth Huntington

IT was the lazy hour just after noon in the square, sunny court-yard of the great khan at Eregli, the present terminus of the Bagdad Railway. A line of round-topped, long-bodied wagons, black or white, was drawn up on one side of the yard, while on the other a group of travelers and guests squatted on their heels in the shade, rehearsing the time-worn gossip of the ages.

Now and again a wagoner in skin-tight trousers and a girdle reaching nearly to his armpits stirred up the buzzing flies, as he sauntered to the well in the midst of the hot court to draw water for his patient horses.

The "odabashi", or "chief of the rooms", emerged from the steamy atmosphere of the coffee-seller's shop beside the wide street door, and went aloft to a flagged porch on the second story, bearing on his uplifted hand a tray laden with blue bowls of curdled milk, flat cakes of bread, a plate of cool, insipid mulberries, and some tiny cups of unsweetened coffee thick as pea soup.

Through the outer door one caught a glimpse of the inevitable oriental bazaar, where peasants in dirty white drawers bargained with leisurely merchants in baggy blue trousers, who sat contented in their little shops selling cloth, raisins, peas, rice, and strange brown substances with lingering, indescribable odors. Turks, Greeks, and Armenians were there, but not a man of any race showed signs of haste. Why should a man hurry at noon of a summer's day with the thermometer over 90? or why, in fact, should he ever waste the precious hours of life by haste?

The stillness was broken by Luiso, the wily Greek wagoner, whom I had hired to drive me out into the Axylon, the great dry plain which occupies the center of Asia Minor north of Eregli. He looked very clean, as he reported that he had been to the public Turkish bath at my expense, according to orders, but he could not see the sense of such a proceeding, for he had been there only two months before.

LIBERTY FROM A SOLDIER'S VIEWPOINT

Early the next morning we started off, accompanied by a mounted gendarme, a needless encumbrance taken to add to our dignity. He was a gruff old Turk, who soon began to grumble about his wrongs.

"What's all this talk about liberty and a constitution?" he growled. "Look at my gray hairs. Haven't I served the government faithfully for 40 years? And now, just because there's liberty, little boys with piping voices are put in our places—mere school boys, 17 or 18 years old, with soft cheeks, who cannot even raise a mustache. They can read and write and all that, but what do they know? When they have to ride 10 hours with the post some night they don't even know the road, and shiver and shake like frightened women. What's this liberty good for? It hasn't brought me the 20 months' pay that the government owes me, and now I shall be thrown out to starve because they say we old men make the villagers support us. Hasn't a man got to live? I don't want liberty. I want to be free to get a good living."

Thus he talked as he rode beside the wagon through the pretty gardens of the oasis of Eregli, past the miles of reed-beds which form the miscalled Lake of Ak Gyöl, and out into the great dreary plain of the Axylon. When he fell behind for a space the Greek took up the complaint, and said that liberty might be all right, but so far as he could see it was liberty for the Moslem and not for the Christian.

WHEN PROSPERITY RULES

Everywhere we found the people of Asia Minor wondering why they are poor, and why this new liberty of which all men talk, but of which no man knows anything, does not make them prosperous.

We, too, had often wondered why this land, where Midas turned all things to gold and where Crœsus was richest of mortals, is now so poor, and it was largely to study this problem that we had come back once more to Asia Minor.

During the past two years Turkey has experienced a wonderful transformation. The new régime has not brought all that the ignorant expected, but it has done much in spite of the complaints heard on every side. Back of the present low estate of Turkey, however, there lies a train of centuries of gradual decay, and this it is which renders the task of regenerating the empire so difficult. Since the days when Asia Minor was in her prime, 2,000 years ago, something has surely changed. Is it the race of the inhabitants? Is it their religion? Is it the government? Or is it nature herself? The change cannot be due purely to the coming in of the Turkish race, for the majority of the people of Turkey, although Turks in name, are not such by blood. Moreover, although the Turks have many faults, few thoughtful persons who have lived in their country will deny that under favorable conditions it is hard to find any people more sober, peaceful, and industrious. Nor is the change from the prosperous conditions of the past wholly a matter of religion, for Mohammedanism can scarcely be considered worse than paganism. So long as prosperity is the rule, Mohammedans and Christians get along admirably, but trouble arises at once when there is poverty or distress. Nor is the government responsible for all the decay in the civilization of Turkey, for today the worst conditions are found in just those places where the government has least authority; for instance, among the Arabs and Kurds. Beyond question the country has suffered deplorably from racial weaknesses, from religious dissensions, and from governmental oppression; but back of these and ever aggravating them, and sometimes causing them, lies another factor—a change in nature herself.

Nomadization, so wise men say, has been the bane of the Turkish empire. Vast areas which once were prosperous agricultural districts have now been given over to nomads and their flocks, and this has led to disorder and to the breaking down of the ancient high civilization of the land. It has often been said that nomadization is a result of the racial character of the Turks, and such is the common statement in histories. The observations which we made during the work of the Yale Expedition of 1909 throw much doubt on this assertion, and make us believe that nomadization is largely due to a change of climate. It was the study of this problem which led us out into the dry plain of the Axylon, lying at a height of about 3,000 feet above the sea. It occupies many thousand square miles in the center of Asia Minor within a great ring of peripheral mountains which border the coast and keep out the rain.

HOSPITALITY A TURKISH CHARACTERISTIC

Our first day's ride came to an end soon after 2 o'clock, at a sad adobe village of dingy gray set in the midst of a smooth brown plain of fine-grained lacustrine clay. A parching south wind had raised the temperature to 101 degrees Fahrenheit, and the heat was so oppressive that we all lay down to rest in the mud guest-room.

After half an hour my drowsy thoughts were interrupted by a plaintive childish voice which seemed to be addressing some one who would not answer. After it had spoken two or three times I perceived a dirty, rosy little youngster standing in the middle of the room and timidly inviting the sleepers to drink coffee, while his mother hid her face in her veil and peeked in at the door. When I had drunk the contents of one of the little cups down to the half-way line, where the beverage becomes solid

A CART ON THE BORDERS OF PHRYGIA

A CIRCASSIAN WATERING CART, MADE OF A SINGLE LOG, IN THE MIDAS VILLAGE

THE TOMB OF THE KING OF MIDAS (SEE PAGE 841)

grounds, the child would not be satisfied until I said that it would be all right to put down the cups for the others to take when they awoke. He had been so well trained in the hospitality which is almost universal among the Turks that at the age of five he felt greatly distressed for fear he might fail to do his duty as a host.

SENTINELS OF THE DESERT

For the next week or more we rode across the vast barren plain. On the edges it is diversified by ranges of volcanic mountains, while from the plain itself symmetrical brown cones of extinct volcanoes rise to flat tops, in which lie gracefully rounded craters. Near Kara Punar we came to an odd type of volcano. The plain is composed of ancient lake deposits, which have been consolidated into a soft marl alternating with sandstone of a grayish brown color. In these deposits a hole a mile or more in diameter and nearly 200 feet deep was formed many thousand years ago by a volcanic explosion. In the middle of the hole a cone of slag and scoria was built up until it rose well above the level of the plain. When the internal forces of old Vulcan ceased to act, a pretty cup of a crater remained in the top of the cone, while at its base an annular depression surrounded the cone and was itself surrounded by the gray cliffs of the lake deposits. Today the depression is occupied by a lake, narrow and ring-shaped and very salty. In winter the lake fills up to a considerable depth, but during the long rainless summer evaporation reduces its size and causes the water to become so concentrated a solution that much salt is deposited.

VALUABLE SALT DEPOSITS

In May salt-gatherers arrive and keep on working for about two months, when the water is almost gone and the deposits begin to contain not only common salt but other distasteful chemical compounds.

As we came to the edge of the hollow and looked down at the annular lake a strange sight presented itself. The lake was so far dry that part of its ring was waterless, and was covered with green reeds; another part was white with salt, and still another contained muddy blue water ringed around with white salt, outside of which was a ring of green reeds. Back of the reeds in the center rose the black and red slopes of the volcano, while on either side stood the steep gray and brown cliffs of the lake deposits. In the large pond at the foot of the slope below us 40 or 50 men were wading knee deep, or were stooping to get hold of something at the bottom of the water. In their hands they brought up great masses of dainty square crystals of salt, which they placed in little piles whose tops touched the surface of the muddy pond. When each man had gathered enough he brought a sieve like an ash-sifter and used it to carry the salt ashore, and piled it up among the reeds in glistening little cones from two to four feet high, shining white as snow against a bright green background.

It is hard work to gather the salt, for the constant dipping of the hands into the briny water and the rubbing of the finger-tips upon the mud of the bottom soon causes sores. A man can work only from four to six days at a stretch, after which he must let his hands rest a few weeks and get well. An industrious man can earn high wages, however—80 cents a day if he is very energetic—so there is no lack of laborers. The salt works are owned and run by the government, which sells the product at the rate of about 10 pounds for 8 cents.

HOW THE LOWLY LIVE

In order to see as much as possible of the life of the people, I traveled as the natives do. Each morning we started soon after 5 o'clock, in the cool beauty of the dawn. Sometimes we ate a little bread before starting, and sometimes took a bite in the wagon. There was no real meal, however, until 10 or 11 o'clock. Then, as the heat grew great, we stopped at one of the clusters of from six to a dozen houses which sprin-

kle the plain at intervals of 3 or 4 miles. They are poor little hamlets, composed of houses of mud or stone, just high enough to allow a man to stand upright.

Not a scrap of green relieves the brown monotony, except in one or two cases where some industrious soul carefully draws water from a deep well and daily waters a few sorry vegetables enclosed within a mud wall.

At first it puzzled me to know how the soldier always picked out the guest-house with unfailing accuracy. I soon saw, however, that the guest-house, which, like most of the houses, consists of only a single room, never has hay stacked on its top. Also, it is regularly located a little to one side of the main body of the hamlet, in such a position that the guests, as they ride up, may not pass close to the other houses, nor, as they sit in the cool of the evening before the door, be tempted to admire the women on their way to the well for water.

On arriving at the door of the guest-house, one merely goes inside and sits down. By and by a boy or man appears and says, "You came well," to which one answers, "We found things well." Then the villager roasts coffee over a fire—unless he has some old and much-cooked grounds on hand—pounds it in a mortar, boils it, and offers the guest a drink. If one stops at a guest-house in the afternoon, nothing more happens until evening, except that the men drop in one by one to hear the news, as the word of the presence of strangers spreads to the fields and herds. If one stops at 10 or 11 o'clock in the morning, however, nothing but patience is required in order to get a meal of the best that the village affords.

TURKISH DISHES

Sometimes we had bread fried in fat; often we were regaled with cracked wheat, also cooked in fat, or with a dish of fried eggs, to which flour was added with a liberal hand to soak up the grease. By way of relishes the richer folk sometimes brought us summer squash or egg-plant stewed with butter, or a mess of greens raised in a tiny garden plot and watered with infinite pains.

The dish which stays longest in memory is "airan"—thin sour milk, in which floated small cubes of cucumber and a few tiny bits of raw onions, which had been grated into it to give it a cooling flavor.

When the traveler has eaten his fill, more coffee is served, the hosts go about their business, and the traveler is left to sleep a little or to resume his journey. Payment is not asked nor expected, and even to offer it is in many places regarded as discourteous.

The little hamlets where we stopped day after day are all occupied by Turks, who lead a semi-nomadic life. Flocks and herds are their main reliance, but for a mile or two around most of the hamlets the higher parts of the country are planted with scanty crops of grain, chiefly a peculiar red wheat, which was being harvested at the time of our visit, in early July. Almost universally the wheat seems to be planted in the very dryest, highest places, while the relatively low places, where there is a fair amount of water and a hint of green grass, are not tilled. Luiso, the wagoner, noticed this and had much to say about the stupidity of people who let good land lie waste and threw away their time in trying to raise crops where nothing would grow.

AGRICULTURAL POSSIBILITIES

Near Lake Tatta, the large central salt lake of Asia Minor, we rode for days over a comparatively green plain with running water in various places, yet without cultivation. Here the strictures of the Greek reached a high pitch of irony. "Look at these idiots," he said. "Just put some Greeks here, or some Muhajir Turks—that is, immigrants from European Turkey—and see what beautiful farms and gardens they would make. These people are fools to live in poverty and wander around with their cattle when they might live in one place and be rich."

It almost seemed as if he were right.

HEAD OF A COLOSSAL LION, FALLEN FROM A TOMB OF THE DAYS OF MIDAS

The outline of jaws and head may be more clearly seen by turning the picture on end

The crop of 1909 was so poor that in many places it was impossible to cut it with scythes or sickles. The only recourse was to the painfully laborious method of pulling the grain up by the roots. The season was so dry that many people did not get back even the seed they had planted. Those who got two bushels of grain for one of seed felt satisfied, and those who got three congratulated themselves. Often this same thing happens, and generally there is a period of perhaps five or six years out of every thirty when the crops are flat failures. At other times they are often poor—so poor that no people who were not very industrious and very much in need of the scanty harvest would take the trouble to reap them. Yet the Turks of the Axylon do not cultivate the moist, green parts of their plain. Instead, they depend upon their animals and change their habitat at least twice a year.

In winter they live in large villages, usually at the foot of the mountains, or in some other location where there is an abundant supply of drinking water. There they gather for five months for the social season, from November to March. One such village which we visited contains about 600 houses, each one with a huge stack of greenish-yellow hay on its flat roof and a few sheds and yards about it. The place is called Sultan Khan, from the magnificent ruined Seljuk khan or inn, with an exquisite façade of varied marble, erected in 1277 A. D. A place with a domed inn like this, over 400 feet long and 160 wide, must once have been of much importance. Today it is an insignificant village, with a little khan where a few travelers stop on their way from the salt works of Lake Tatta to Konia, the ancient Iconium from which Paul, the Apostle, was driven out.

When we visited Sultan Khan there were not half a dozen people there beside the keeper of the inn and his servant. All the rest were scattered over the

RAMPARTS OF LIVING ROCK AT THE CASTLE OF PISHMISH KALESI, WITH THE MIDAS MONUMENT IN THE DISTANCE
(SEE PAGE 841)

plain at the 57 yailas, or summer hamlets, where they stay from April to October. There they feed their flocks, for it is only by scattering themselves over a broad area that sufficient grass can be found for all the animals which form the chief means of livelihood. The great flocks of sheep stay at the yailas all the year, cared for by a few lonely shepherds. The other animals—horses, cows, camels, and donkeys—are taken to the large villages in winter and fed on the hay stacked on the roofs. In summer, however, they, too, are taken to the yailas. This sort of nomadism prevails over large parts of the plain of the Axylon. Once the case was different.

ANCIENT ARCHITECTURE OF THE NOMADS

In the days of Midas and Crœsus, and in the times of the Greeks and Romans, nomadism appears to have been unknown in this part of the world. The chief proof of this lies in the large number of ruins, all of which, to judge from the style of architecture and the nature of the Greek inscriptions, were inhabited at about the beginning of the Christian era. During nine days' travel in the plain of the Axylon, I passed through 16 actual modern villages, as distinguished from yailas or summer camps. I made no special attempt to visit ruins, merely examining those which came in my way. Nevertheless I passed through the ruins of 42 genuine villages, not to mention various small isolated instances. Most of the 16 sites now occupied by modern villages were doubtless also occupied in the past.

It is certainly safe, then, to say that the number of ancient villages was at least 48, or three times as many as exist today. Probably all these villages were occupied at the same time, during the days of greatest prosperity, but, even if only half were occupied, the population must have been much greater than at present, for the old villages were almost universally larger than the modern ones. They must have been much richer, also, in order to erect the fine buildings whose carved columns are found in large numbers.

AN ANCIENT FLIGHT OF STEPS CUT FROM SOLID ROCK BEFORE THE MOSQUE OF SAVATRA

Take, for example, the village of Ak Viren, in the middle of the plain. The place has no running water, but depends upon deep wells. The inhabitants cultivate a considerable amount of land, but rely mainly upon their flocks for sustenance, because the crops are so poor and precarious. The present population numbers 130 families, whose houses are scattered irregularly among extensive ruins. Once the town was a fine place, the capital of the district. Savatra, as it was called, boasted some excellent buildings, in one of which was placed the flight of seven steps shown in the above photograph. They were carved from a solid block of limestone and are now preserved in the yard of the mosque. The old town occupied an area which I estimated to be ten times as large as that of the modern village. Other ruins are correspondingly larger than their modern representatives. In view of all the evidence, it seems con-

GENERAL VIEW OF THE TOMB OF MIDAS AND OF THE MODERN CIRCASSIAN VILLAGE AT ITS FOOT

servative to say that 2,000 years ago the population of the plain of Axylon must have been at least five times as great as now. With such a population, and with towns of such large size, a semi-nomadic life like that of the present day would be impossible.

The former prosperity of Asia Minor is admirably illustrated by the tombs, castles, and other monuments found among the Phrygian Mountains, west of the plain of Axylon. Here lies a pleasant region, wooded with fine pines which cover breezy ranges of hills and surround fertile valleys. Rain is more abundant than in the plain of the Axylon and the population is correspondingly denser and more prosperous. The inhabitants are of exactly the same race as those of the Axylon, and they profess the same religion and are subject to the same government, but their mode of life is different. Nomadism is unknown, for the good reason that it is not necessary, because as a rule the crops are good, and even in bad years there are no such complete failures as in the plain farther east. Nevertheless the Phrygian Mountains are not a rich region, and often the crops are so scanty that distress ensues, for here, too, the long summer is rainless.

THE FABLED WEALTH OF ASIA MINOR IN THE PAST

About 2,600 years ago Phrygia was the home of a dynasty of kings who went by the name of Midas. The fame of their wealth spread far westward to the Greeks on the coast of Asia Minor, and so to Greece itself. We do not know how rich they actually were, or how prosperous their country was, but we can judge somewhat from the ruins which they have left behind. The most famous is the so-called Tomb of Midas, a perpendicular surface of rock 55 feet high and 50 feet wide, covered with ornaments in a complicated rectangular pattern of crosses, meanders, squares, and other devices, surrounded by a long Phrygian inscription. Its appearance is shown in the illustrations. It is unknown whether it was the Midas mentioned in this inscription or some other of his dynasty whose wealth gave rise to the famous tradition, but it is evident that a people who could build such monuments must have been not only prosperous and wealthy, but somewhat highly civilized. Scores of other monuments and well-wrought tombs are scattered through the country.

Great castles were built to protect the towns, and the great "Royal Road" to Persia passed this way. So abundant was labor and so prodigal the kings that when a rampart was planned for the castle of Pishmish, facing the Midas tomb a mile or more to the east, the whole top of a huge isolated rock was cut away, forming a platform around the edge of which was left a wall of living rock. Today the site of the city of Midas is occupied by a village of poor but industrious Circassians, who bewail the fact that they were ever persuaded to leave their homes in the Caucasus for a region where they continually suffer from poverty.

THE CAUSES OF THE POVERTY OF TODAY

To go back now to the cause of the present poverty and nomadism of the plateau of Asia Minor. In the first place, the people of the Axylon and other regions are not nomads by choice, but by necessity. They regret that they cannot cultivate more land. The damp areas which aroused the scorn of the Greek wagoner are untilled for the good reason that they are so saline that crops will not grow. I examined the matter with care. In several cases I found rich men who have recently tried to use the streams for irrigation. In each case there has been a good growth the first year, but in the succeeding seasons rapid deterioration has set in. The little trees, which start out bravely, pine away and die; the vegetables, which grew vigorously the first year, are sickly the second, and fail utterly in later years. It is possible that modern methods might redeem the land, but no methods used in the East could do so.

Again, in the higher parts of the plain, where there is no trouble from salt, there

A FLAT-ROOFED ANATOLIAN VILLAGE

The village lies near the forested Phrygian mountains, and therefore employs an unusual amount of wood

GATHERING SALT IN THE VOLCANIC LAKE (SEE PAGE 835)

SUMMER HOUSES OF NOMADS IN THE AXYLON

WINTER VILLAGE OF NOMADS IN THE AXYLON

TENT OF A KURDISH CHIEF IN THE AXYLON

THE WOOD MARKET AT AFIUN-KARAHISSAR

BOUND FOR THE WEEKLY MARKET

WINNOWING THE WHEAT AFTER IT HAS BEEN THRESHED BY A SLEDGE DRAWN BY OXEN

is endless trouble from lack of moisture. If the inhabitants tried to rely upon agriculture they would either starve in a few years or be forced to abandon the country. Thus it appears that here, and also in almost all other parts of Turkey where nomadism is practiced, the people must either depend upon flocks, and wander from place to place, or must give up the country entirely. Therefore it is not the people who have nomadized the land, but the land which has nomadized the people.

In ancient days nomadism was not necessary, because then the climate was moister than now, so that the dry places were damp enough for crops and the saline places were in many cases kept fresh. The proof of this is abundant. It consists partly of the strands of old salt lakes which are proved to have stood at much higher levels in the past than in the present, showing that they received more water.

Another line of evidence is found in the location of old cities. Sir William Ramsay, the greatest authority on the geography of Asia Minor, says that in ancient days the chief towns were located where it was most convenient for trade or for defense. In modern days, however, the locations have often been changed, he says, to sites less convenient than those of the past, but which have the advantage of a larger water supply. That is, great towns could formerly be located almost anywhere, because everywhere there was enough water. Now, towns, even of smaller size, cannot be located except in places where there is an exceptional amount of water.

Another kind of evidence is found in towns like Ak Viren, already mentioned. Here the chief town of the region grew up in a place that is now not only too dry to support a large town, but absolutely devoid of anything to support a small town. Semi-nomads, like those of the Axylon plain, could never build a fine little city such as old Savatra. It could have grown up only at a time when the plain was so well watered that good crops could be grown everywhere.

Scores of other facts point to the same conclusion. The change is not due to the cutting off of forests, for it occurred over a vast area, including Arabia, Syria, Persia, and Turkestan, as well as Asia Minor, and in much of this region there is no evidence that forests ever existed during historic times. It has also occurred in places where forests once existed but are now gone, and in places where they have always existed and still survive. Hence it is a general change, affecting all of Asia from western China to Asia Minor, and probably a far larger area, extending eastward to the Pacific Ocean and westward to the Atlantic.

CLIMATIC CHANGES PAST AND PRESENT

The change from the conditions of the past to those of the present has not progressed uniformly. About 600 years after Christ there was a period of a century, more or less, when the climate was even drier than now. When the change took place from the previous moist conditions to the great aridity of the seventh century, hundreds of thousands and possibly millions of people in the drier parts of Asia began to suffer from lack of water for their crops and grass for their cattle. Their families were hungry and their children cried for bread. So the fathers cast about for new places to occupy, and began to move this way and that in great hordes, taking with them their wives, children, cattle, and household goods.

Thus, apparently, arose the great migrations which overwhelmed Europe in the Dark Ages. It was hunger, due to drought, which made the early Mohammedans so terrible a scourge. Hunger drove them and religious fanaticism united them. In the great changes of this turbulent time the last vestiges of the wealth of the land of Midas were swept away, for no land can be rich if its people suffer from hunger.

A TALK ABOUT PERSIA AND ITS WOMEN

By Ella C. Sykes

Author of "Through Persia on a Side-saddle," "Story-book of the Shah," "Persia and Its People"

With Photographs by H. R. Sykes

PERSIA is one of the oldest empires in existence. It has been a kingdom for 25 centuries—ever since Cyrus the Great, about 550 B. C., conquered Media and united that country to his under the name of Persia. It has had many glorious episodes in its long history; has produced the great teacher Zoroaster; such world-famous poets as Firdawsi, Omar Khayyam, Saadi, and Hafiz, and such great soldiers and rulers as Darius I, Shapur I, and Shah Abbas.

Again and again the empire has been a prey to anarchy; again and again conquering hosts have swept through the country, Alexander the Great having many a successor, the most destructive conqueror being Chinghiz Khan with his hordes of savage Mongols—a leader who boasted that he had slain thirteen millions of his fellow-creatures!

At the present day, though shorn of its former dimensions, Persia is more than three times the size of France, yet it has only nine and a half millions of inhabitants—15 to a square mile. As the population of the whole country is not equal to that of London, New York, and Paris combined, none will be astonished to learn that it is possible to travel for days at a time without coming across a village or even a human being.

The center of the country is a great plateau, rising from 2,000 to 6,000 feet, and crossed by frequent chains of mountains, while a lofty mountain barrier bounds it on the north and south.

The climate on this plateau is a fine one—dry and bracing, cold in winter and often intensely hot in summer. When living in the southeast, the writer's home was at a height of 5,600 feet, and in order to escape the summer heat she camped at an altitude of 11,000 feet among the running streams and bush herbage at the foot of a snow-capped range. The Lut or desert, once an inland sea, occupies the center of Persia, cutting off the north from the south and the east from the west, and thus rendering communication difficult. In fact, it helps to make transport so costly that the different districts and principal towns are practically isolated, and cannot depend upon other parts of the country, even in such a case as that of famine.

There are great differences of climate in the kingdom, the low-lying, feverish district round the Caspian, with its dense forests and 50 inches of rainfall, being in complete contrast to the arid uplands, where as a rule not a tree or a blade of grass is to be seen save on the irrigated ground round a village.

Again, on the shores of the Persian Gulf, the moist heat during summer is well-nigh intolerable to Europeans, and the groves of date-palms that constitute the wealth as well as the staple food of the inhabitants are only possible where there is irrigation, so rainless is this torrid region.

INADEQUATE TRANSPORTATION METHODS

In the whole Persian Empire there are only six miles of railway, and of roads only four, their total length amounting to under 800 miles. There is only one navigable river, the Karun, that flows into the head of the Persian Gulf, and on this sea the so-called ports are merely open roadsteads, at which cargo cannot be landed in stormy weather.

The merchandise of Persia is practically carried on the backs of camels, mules, and donkeys, a slow and expensive mode of transport, and the traveler usually rides through the country follow-

A CARAVANSERAI; THE PERSIAN HOTEL

A COOK-SHOP

PERSIAN BOYS

THE SHOP OF A VILLAGE BUTCHER

DERVISHES

ing the tracks made by the passage of caravans during the centuries.

It will be understood from what has gone before that hotels must be bad, if not non-existent, and indeed the ordinary caravanserai, swarming with vermin, with only openings in its walls in place of doors and windows, with no furniture of any description, and hardly any food, would appall any one unaccustomed to Eastern travel.

The Persian is of Aryan stock, and has the same words as ourselves for father, mother, brother, and daughter (*pidar, madar, bradar,* and *dukhtar*), and the construction of his language is like that of English.

He is a handsome, well-built man, with regular features and fine black eyes, his complexion being no darker than that of an Italian. In manner he is most courteous; he is quick, alert, fond of conversation and discussion, and has been rightly called the Frenchman of the East.

Persia has been a Mohammedan country from the time of its conquest by the Arabs, in 641; but some thousands of Zoroastrians, the old fire-worshipers, still remain in the land, and have been much persecuted.

PERSIAN MUSICIANS

THE AUTOCRAT OF THE HOUSEHOLD

In order to understand Persian domestic life at the present day, we must carry ourselves back to patriarchal times. The Persian is lord and master of his house much as was Abraham or Jacob. He has enormous power over the persons of his wives, children, and dependants, all of whom he can treat much as he pleases.

When a woman is handed over to her husband with her dowry, he regards her far more as a chattel than as a wife. She may never show her face to any man save her husband and near relatives, and, owing to the extreme seclusion in which she lives, it is most difficult for her to get justice should she be ill-treated. There are certain laws for her benefit in such cases as that of divorce, but these are only enforced when a man divorces his wife.

If the case be reversed and the woman carries her slipper to the judge and demands separation from her husband, the latter is not obliged to refund the dowry that he received with her.

Brutal husbands who wish to be rid of their wives and yet retain their dowry sometimes ill-use them in order to force them to sue for a divorce themselves.

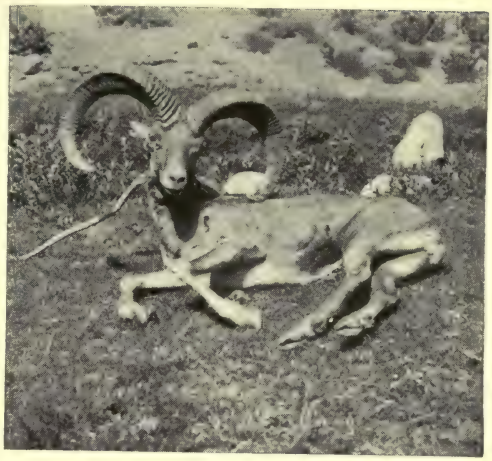
If a man is angered with his wife and says three times, "I divorce you!" he has legally severed himself from her, and, should he desire to have her back again, she will be obliged to marry and then be divorced by another man.

The happiness and position of a Persian woman usually depends upon her children. Her great wish is to present her lord with sons. "He that has no son has no light in his eyes" is a well-known saying, and a man feels that he is disgraced if he has no heir to carry on his

A FIRE-WORSHIPING FAMILY: TEHERAN.

Photo by M. Sevraguine

name. When a child is about to come into the world two cradles and two little suits of clothing are in readiness. If a boy make his appearance he is placed in a silken bed and clad in beautifully embroidered garments; but if a girl should arrive to her falls the cotton cradle and the common attire. Her nurse goes in fear and trembling to break the news to the father, who may, in his anger, order the luckless woman to be bastinadoed instead of giving her the gift that would have been her due had she announced the birth of a son. From the moment of his entrance into the world, throughout his entire life and even in the hereafter, the Persian man has decidedly the best of everything and the woman the worst.



WILD SHEEP SHOT BY MR SYKES

MOULDING THE CHARACTER OF THE YOUTH

The man of well-to-do parents receives his education from a *mulla,* or priest, who teaches him to read and write, and to recite the Koran in Arabic, probably without understanding a word of the Mohammedan bible. At about eight years of age he is more or less separated from the women, and now practically lives with his father and with the latter's men friends, being in the charge of servants who teach him to ride and to shoot.

His dress is that of his father's in miniature — the brimless astrakhan hat, the European trousers, the frock coat much kilted at the waist, the vest of Kerman shawl, and often the elastic-sided boots. He will accompany his father when visiting, and soon learns the elaborate code of Persian etiquette, being careful to address royalties, officials, church dignitaries, merchants, and so on by their proper titles, and deal out to each the right amount of courtly phrase. He will be told to speak of himself as the *baudeh* or slave of any superior, but will be warned that it is considered sarcasm if he gives to any man more compliment than is his due.

The "strenuous life" finds no favor in Persia, the ideal of a young Persian being to act as a hanger-on at court, or to be included in the suite of some governor of a province or high official, such sinecures being spoken of as "doing service".

The Persian, however, is a fearless rider and a keen sportsman. He loves to gallop his horse at its fullest speed, digging the points of his shovel-shaped stirrups into its ribs to urge it to yet greater efforts; and then he will pull it up suddenly with the severe Persian bit. Or he will take part in a gazelle hunt, making one of a large circle of horsemen, who gradually hem in a small herd of these shy animals, drawing closer and closer until the terrified *ahu* attempt to break through the ring. Then the sportsmen fire at their quarry, Persians being so reckless in moments of excitement that sometimes the riders get shot instead of the game.

To climb the mountains after the ibex and wild sheep is the hardest form of sport, and hawking and partridge shooting are also favorite amusements. Nothing, however, comes amiss to the gun of a Persian, who will bring down a crow or any small "cockyolly" bird if no better game is to hand.

The well-to-do Persian is roused before sunrise by the call of the *muezzin* summoning all men to prayer. He throws aside the padded quilts that form his bed, hastily dons his garments, and exchanges the felt skull-cap in which he

A STREET IN A PERSIAN TOWN

A CAMEL BOY

Photos by M. Bourke

SCENES IN A PERSIAN BAZAAR

CUTTING UP A CAMEL FOR FOOD

OXEN PLOUGHING

sleeps for the black lamb's-wool hat. His servant then pours water over his hands, and he washes his face, arms, and feet before prostrating himself on his prayer-carpet, which is turned in the direction of Mecca.

After his devotions (which he repeats at noon and at sunset) are accomplished, he partakes again of much-sweetened tea without milk, and with it eats a thin cake of flabby bread and some sweetmeats. Then he smokes a *kalian,* or water-pipe, and feels fortified for the work of the day, whatever it may be.

At noon an ample repast is served on a leather cloth laid on the ground, and the standing dish will be *pilau,* which consists of a mound of beautifully cooked rice mixed with chopped meat and vegetables.

All Persians sit on their heels, and they eat with their fingers, manipulating the *pilau* most cleverly with the right hand, it being a mark of ill-breeding to use both hands when feeding.

The meal is discussed in total silence, and, when all the greasy right hands have been washed with rose water, the party betake themselves to slumber, a midday siesta being indulged in from the highest to the lowest.

Tea, fruit, and sweetmeats are partaken of during the visits which Persians are so fond of making, and often the evening meal is not served until 9 o'clock, all going to rest immediately they have finished eating.

According to the Mohammedan religion Persians are not permitted to indulge in alcohol, and the strict confine themselves to sherbets (fruit syrups). But the wines of Shiraz, Hamadan, and Isfahan, or arrack, the spirit made from grape refuse, prove too strong a temptation to many, and unfortunately the Persian only drinks in order that he may become inebriated.

PRE-MATRIMONIAL ARRANGEMENTS

Friday, the Mohammedan equivalent to the Christian Sunday, is the day when business is suspended in the bazaars, and the faithful resort first to the public baths, and, after their ablutions, to the mosque. Here all prostrate themselves in the direction of the kaaba, the sacred black stone built into the mosque at Mecca, and their devotions are led by a priest, the proceedings terminating with a discourse called the *khutbah.*

When a Persian reaches manhood his parents busy themselves in arranging a suitable marriage for him. As he has never looked upon the face of any lady, unless she be a near relative, he has absolutely no choice in the matter. His mother selects his *fiancée* and he is not supposed to meet her until the public betrothal by a priest takes place.

If he then dislikes what he sees of a face that is almost disguised with rouge and powder, he can draw back, but he has to hand over to the girl's parents half the value of the dowry that he would have received with her, and, moreover, he is socially disgraced.

Marriage is, however, by no means such a serious matter as it is in some countries. The Prophet permits his followers to have four wives apiece and as many temporary connections as they please, and we have already explained how easy it is for a man to rid himself of an uncongenial helpmate.

DOMESTIC LIFE AND CUSTOMS

Moreover, many Persians have no home life in the usual sense of the word. A Persian house is divided into the *birooni,* or men's apartments, and the *anderoon,* or part consecrated to the women. A strong door, set in a high blank wall, gives entrance to a narrow passage that leads into a square courtyard on which open several rooms. Here the men live, and here they usually feed and entertain their friends, while their women dwell in rooms set round an inner courtyard, the only entrance to which is through the *birooni.*

As a Persian is instructed from earliest youth that a woman's advice is of no account—in fact, the priests tell him that he had better do the exact opposite of what a woman counsels—it can be understood that as a rule he has no exalted

opinion of his wife or wives, and seldom turns to them for companionship.

When death approaches, if he has performed his daily prayers, kept the Fast of Ramazan, visited the mosque on Friday, and given alms to the poor, a Persian has no doubts as to his reception in the next world and dies in a happy confidence of attaining to the paradise promised by the Prophet to all his faithful followers.

Rivers of delicious water, milk, and honey flow through beautiful gardens planted with shady trees. These latter thrust their branches laden with luscious foods into the mansions where the faithful, arrayed in silk, lie on couches and are tended by houris of surpassing loveliness.

Seventy-two of these angelic beings fall to the lot of the humblest believer, and they sing enchantingly to him, fulfill his least desire, and make him forget the women he has known on earth.

THE RESTRICTED OPPORTUNITY OF PERSIAN WOMEN

And now I will ask the reader to turn to the life of the Persian woman and contrast it with that of her lord and master.

Often she comes into the world unwanted and meets with no welcome, and through life she is usually neglected and made of little account. Sometimes she is educated with her brothers up to the age of eight, but after that she is separated more or less from them and is relegated to the *anderoon*.

In Persia it is rare to find a woman who reads or writes, and a girl will employ her time in embroidery, in making sweetmeats and sherbets, and in much gossip with her women friends and servants.

Her indoor dress in summer is a gauze jacket, and very full, short trousers that do not reach to the knee, this latter garment being introduced by Nasr-ed-Din Shah, who was greatly fascinated with the costume of the Paris ballet girls.

A Persian lady cuts her hair in a straight fringe across the forehead and mixes her tresses, if not abundant, with horse-hair; but she always covers her head with the *chargat*, a handkerchief of fine muslin that she wears by day and night, and which it would be the height of impropriety to remove.

In appearance she has fine eyes and good features, small hands and feet, and a figure usually too stout for European taste, while, owing to her secluded life, she often looks dull and unintelligent. Her fondness for cosmetics leads her to rouge and powder her face most inartistically, and she uses *kohl* to impart a languishing look to her eyes and to double the width of her eyebrows, making them sometimes meet at the bridge of her nose.

When a woman wishes to leave the *anderoon* her dress is a complete disguise. She draws up to her waist a garment, socks and trousers in one, and over this she drapes the *chadar*, a large black wrap covering her from head to foot. Hiding her features is a white silk or cotton cloth with just a strip of lace-work across the eyes, and death would be the penalty were a man rash enough to raise that face-cloth. Heelless, flapping slippers complete a costume which is almost suffocating in the summer heat, and which at any time makes its wearer look like a waddling bundle.

The public bath is the Persian woman's chief dissipation. Here she meets her friends and spends many hours in the hot, steamy atmosphere, while her servants dye her hair with henna and indigo and tint her nails and the tips of her fingers and toes with the scarlet juice of the former plant.

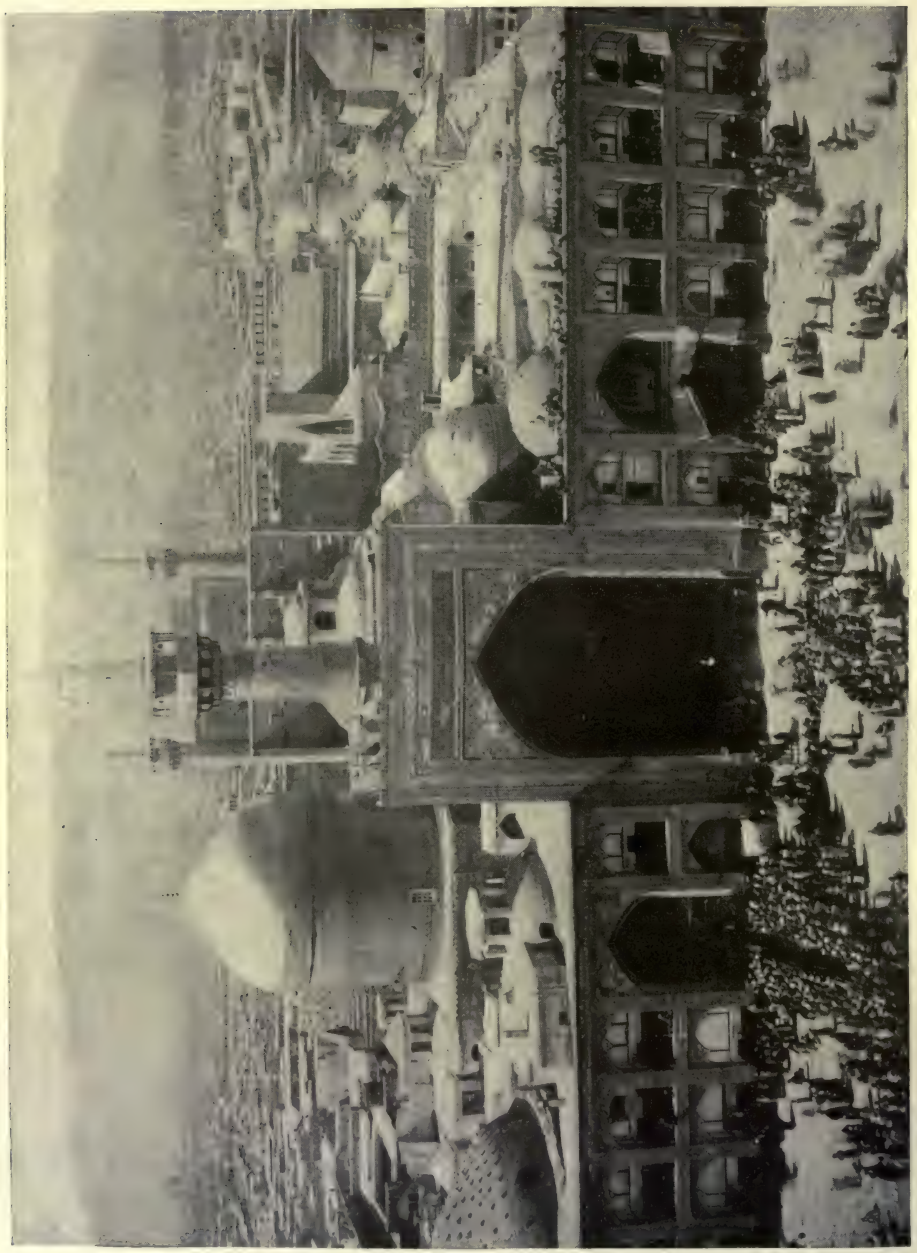
Perhaps she will go to the mosque on Friday, but if she does so she will be confined in a closely latticed enclosure from which she can see and hear but little of the proceedings.

HER FATE DECIDED BY OTHERS

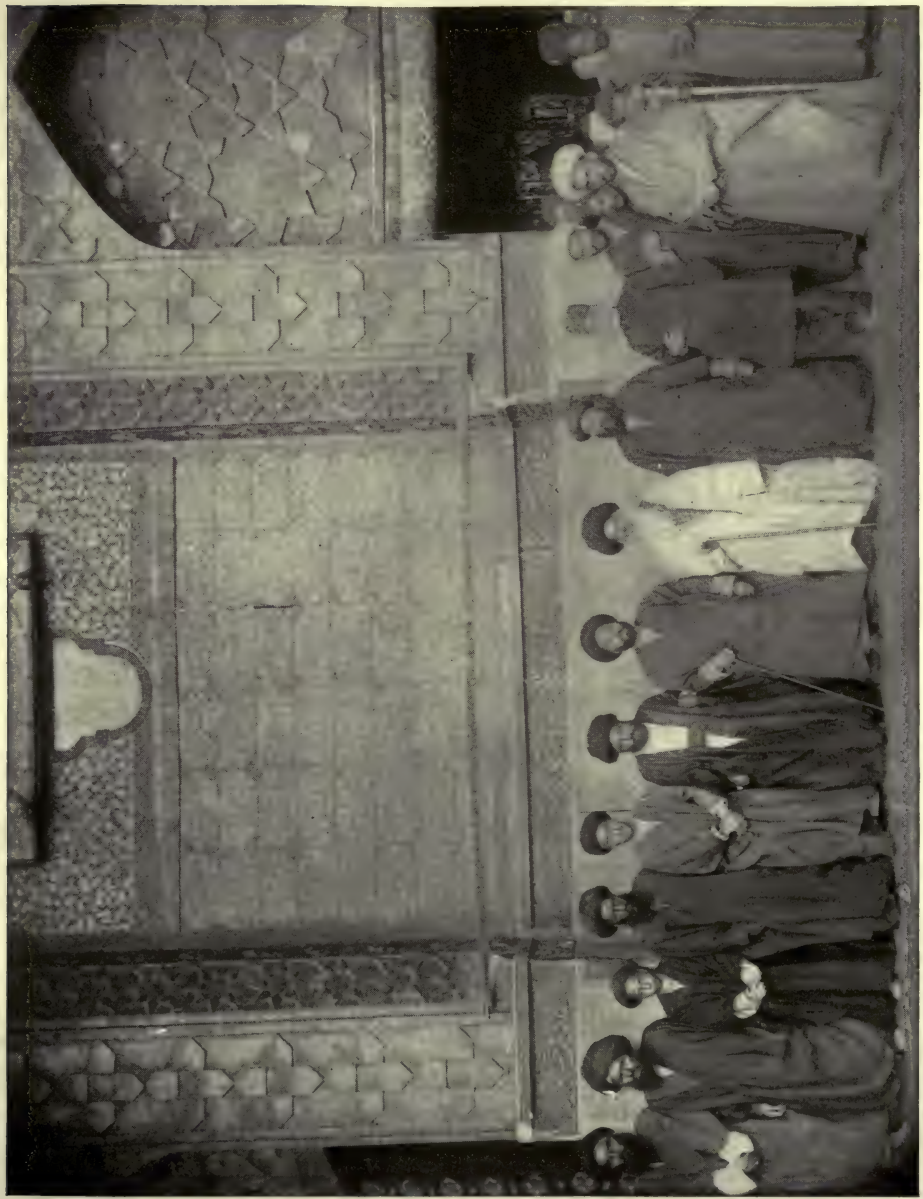
Of course marriage is the great crisis in a girl's life, but in this, as in everything else, she has no choice. Her parents often have no idea of consulting the tastes of their daughter, and girls are

ENTRANCE TO A PERSIAN VILLAGE

A PERSIAN PEASANT FAMILY



THE SHRINE OF THE IMAM REZA AT MESHED



GOVERNOR AND THE OFFICERS OF THE SHRINE "IMAM REZA"

A ZOROASTRIAN OR FIRE-WORSHIPER

MESHED: THE SHRINE AND MOSQUE

sometimes handed over to men old enough to be their fathers or even grandfathers; there is also much marriage among cousins in order to keep the property of a family together.

Once married, the young wife's strongest wish is to become the mother of a son, for she knows that her husband's affection, and, in fact, her entire position, depends on this. If no son is born to a man he will take to himself a second wife, or perhaps divorce the first, and it may easily be imagined what jealousy and heart-burning are roused if there are rival wives in the same establishment.

In any case a wife cannot be a real companion to her husband. It is not etiquette for him to be seen with her in public; he may not salute her should he recognize her in the street; her secluded life prevents her from knowing what is going on in the world, and she is not acquainted with any of his friends, nor can he meet any of hers. Consequently he spends his days apart from her and usually eats with his men friends, the women of the household finishing what he may leave.

A woman's great consolation lies in her children, there being much filial piety in Persia, though the son's love for his mother has apparently no influence on his behavior toward his wife.

TERRORS OF THE HEREAFTER

When a woman becomes old her thoughts turn often to the other world, and she makes up her mind to go on a pilgrimage. The Prophet, it is related, when permitted a glance into hell, found that the great majority of the victims writhing in torment were women. As lions with 7,000 teeth and vipers with 7,000 fangs mingle with fiends, all working away with a will to torture the luckless inmates of the infernal regions, most women would count no effort too great to escape from such a doom. Only by a life of unremitting virtue can they attain to a paradise into which apparently any man may enter with comparative ease.

A woman knows, however, that a pilgrimage to Mecca, Kerbela, or Meshed will save her from the terrible Mohammedan hell, and she cajoles what money she can from her husband, sells her jewels, and starts off with a party of friends and servants. Meshed, being in her own country, is probably the goal of her journey, and what a journey it is for a woman well advanced in years and unaccustomed to exertion! If she cannot afford the swaying *takht-i-ravan,* or litter, she must sit cramped up in a *kajaveh,* or pannier, strapped on one side of a mule, or else ride astride on a rough pack-saddle. However hot may be the weather, she must keep her face covered up and her figure shrouded in the all-enveloping black cloak.

At sunset she will arrive at some caravanserai; her servant will sweep out a recess for her, will hang a carpet before the opening, and spread out her *resais,* or cotton quilts, and all night long she will hear the noise of mules and the talk of the muleteers, and will probably be troubled by the insect life which is very active in these rest-houses.

Day after day her mule jolts her over great plains destitute of a single tree and with only veitch or camel thorn sprinkled on the gravelly soil. She will cross the ranges by passes that lead into other plains, the replica of those which she has traversed; her food will probably be insufficient, and she will be forced to drink water often brackish and sometimes absolutely foul, for she has no filter with which to purify it.

At last, coming to the crest of a hill, she sees the glint of a gilded dome and knows that the goal of her journey, the sacred shrine of the Imam Reza, is not far off, and that from henceforth she will bear the proud title of *Meshedi.* She and all the other pilgrims dismount and prostrate themselves in adoration, and before sunset the party is entering Meshed by a gateway badly in need of repair and our lady's servant has got quarters for his mistress in a house as near the shrine as may be.

The next day she will betake herself to the shrine, where she will be met by a band of *Seyids* (descendants of the

GATEWAY OF A PERSIAN CITY

A VILLAGE PASSION PLAY: NOTE THE WOMEN WATCHERS ON THE WALL

Prophet), one of whom will recite to her the proper Arabic prayers, which she must repeat after him, and he will tell her where to make her genuflexions. She will gaze in amazement at the jewels, the magnificent carpets, and the weapons hung on the walls of the shrine, and she will join the band of pilgrims who pass round the silver trellis-work that encloses the body of the Imam Reza, kissing with fervor the silver padlocks of the gates.

She will also visit the beautiful mosque close by, and will pay a priest to read portions of the Koran to her daily, as it is improbable that she can peruse the Mohammedan bible herself. In the screened-off portion of the mosque, set apart for women, she will meet the friends from her native city, and will spend much of her time in conversing with them. A whole year may elapse before she makes up her mind to return to her husband and family, and indeed she is not greatly needed at home. Her children, if they are young, are in the charge of a faithful slave, and, as her husband has always engaged the servants, and has disbursed all money required for the household and has overlooked the accounts, she is hardly wanted at all.

EARLY PREPARATIONS FOR THE END

Day after day, in approaching the shrine, she walks over a pavement composed of countless flat tombstones, and she sometimes wonders whether she may not have the good fortune to die in the holy city, in which case her bones would be laid to rest in this great cemetery and she would go straight to paradise. Persians pay from $50 to $500 for a grave near the shrine. But they do not remain in possession of it very long. Directly the inscription cut on the stone is worn down by the feet of the myriads of pilgrims, the corpse is dug up and its place is taken by a new occupant with a new stone, or even the old one recut!

If the Persian lady, however, makes her way home, she will die in the odor of sanctity and with the coveted title of pilgrimage, and her body may form one of that terrible caravan of corpses returning to the shrine to be buried that the traveler sometimes meets in the neighborhood of Meshed or of Koom.

When she dies the hired mourners arrive to weep and lament; all water in the house is thrown away lest the inmates be afflicted with colic; a priest recites the Koran, and the corpse is placed in the coffin with a stick under each armpit. This is for the purpose of enabling the deceased woman to raise herself when the blue-eyed angels come to question her as to her orthodoxy. If she can answer to their satisfaction her coffin will expand to the size of a room, but if they are not pleased with her, her last resting-place will close in upon her, all animals being able to hear her shrieks of agony as she is thus tormented. Even if all go well, she has to pass the Bridge of Sirat, "finer than a hair and sharper than a sword," which spans the fires of hell, and only a minority of women can tread this in safety and enter into the regions of the blessed. Here apparently the Prophet did not contemplate that husbands and wives should meet one another again, and we find that the women are relegated to a paradise of their own with angel attendants. In fact, this glimpse of the life of a Persian woman assuredly bears out my contention that she has the worst of it in every way, from the moment of her birth even to her life in the world beyond the grave.

THE POSITION OF THE SLAVE

I have said that Persian domestic life was really patriarchal, and I cannot leave this subject without mention of the servants and slaves who form so important a part of a Persian household. The former are treated as members of the family; their master calls them *batchaha* (children); he feeds and clothes them, and, if displeased with them, orders them to be bastinadoed. They are supposed to be paid their wages in cash, but, as ready money is usually scarce in Persia, their master often rewards them in a somewhat ingenious manner. He will employ them to carry a gift to some

superior, who must give the bearers the value of the offering in coin of the realm. Europeans, on their arrival in the country, are often victimized in this way. A dish of apples, a melon, or perhaps a few limes will be presented to a *feringhi* (foreigner) with great ceremony, the worthless present placed on a beautifully chased metal tray covered with a magnificently embroidered cloth!

The servants purchase everything needed for the household in the bazaars, an honest domestic taking a 10 per cent commission on all he buys, and they collect the gossip of the town with which to amuse their masters. Servants burst into the conversation of their betters at any moment, and, though in some ways they may like the service of a European, with its fixed money wage, yet they constantly feel "left out of it" as they hear the unknown language of their employers.

Curiously enough, the slave has in many ways a most enviable position in Persia. He has cost much money; therefore he is given the best of food and clothing and is never forced to do hard work. Having no family of his own, he is supposed to center all his interests in that of his master, and the latter will often leave him in charge of his children and his valuables. A slave frequently amasses a fortune if he is in the service of a highly placed official, for all visitors will bribe him in order that he may curry favor for them with his master; but he seldom wishes to purchase his freedom.

SUPERSTITION A FUNDAMENTAL CHARACTERISTIC

From this article it will be judged that Persia is neither an enlightened or progressive country; but only those who have lived there can understand the state of superstition in which the people live. Soothsayers and dervishes are consulted on every occasion, no business or journey being undertaken, no doctor summoned, or even medicine drunk unless the omens are ascertained to be propitious.

Ghouls, demons, *jinns,* and *afrits* haunt all ruins and lonely places. The former disagreeable visitants are so active at night that no Persian will sleep alone, and many a well-to-do man hires a priest to share his room and keep off these powers of darkness. The *jinn* is usually invisible, and on account of this no one would dare to fling hot water away with a splash or even throw stones, lest a *jinn* lurking near should be injured and wreak vengeance on its unconscious aggressors.

From the highest to the lowest there is a firm belief in the "evil eye". A prosperous Persian woman will dress her baby boy on his rare outings in common clothing, because, if some passer-by, attracted by fine attire, were to admire the child's beauty without adding the saving expression *Mashallah* (God is great), illness or accident would be sure to follow.

Blue is the color to avert the "evil eye", and all who can afford it wear a turquoise, the poor and animals being obliged to put up with blue glass beads.

Medicine must also be classed among the category of superstitions. A man in a burning fever will be laid in the ice-cold water of the channel that flows through the garden, because he is suffering from hell fire; the *jinns* are supposed to be beating a man in a fit of epilepsy; ground-up rubies and pearls are given to the rich as powerful tonics, and powdered glass is actually used to allay the inflammation in sore eyes! Witchcraft is suspected to be the cause of many an ailment, and there are countless recipes for foiling the exponents of the black art.

But in the limits of a short article it is difficult to do more than give a mere glance at Persia and its people. The writer, however, hopes that what she has written may interest people in a country that has had such a long and often glorious history and that is even now engaged in the difficult experiment of changing an old-world autocracy into a constitutional government.

Khoda hafiz-i-shuma—Good-bye.

THE GREATNESS OF LITTLE PORTUGAL

By Oswald Crawfurd

The early navigators of this youngest of republics discovered Brazil and both of the ocean routes to the Indies—via Cape of Good Hope and Magellan Strait. Her present population is about that of New York City, and her size corresponds to Maine or Indiana. According to statistics, her people have the longest heads in Europe and are also the smallest in stature. Three-fourths of the population above six years of age can neither read nor write, notwithstanding a law passed in 1844 making primary education compulsory. The following article is abstracted from "The Contemporary Review" of Edinburgh.

TRAVELERS leaving the unquiet waters of the Bay of Biscay behind them and getting their first sight of the peninsular mountains on the steamer's port bow must often have asked themselves, How has it come to be that, in this huge Iberian peninsula, one little slice of territory facing the western sea has remained independent throughout the ages, when so many other and seemingly more powerful principalities have tottered and gone to the ground?

Is the country too mountainous and inaccessible to permit invasion and conquest, like Wales or our British highlands? Or is there some peculiar virtue or quality in the inhabitants of this corner of the land that has served to keep it free and untainted by the foot of the conqueror? Or, again, has some one great man stood forth in the hour of his country's need, repelled the invader, and left lasting traditions of freedom and independence, never afterwards to be forgotten?

Nearly all these questions can be answered in the affirmative, and Portugal owes her existence to this day as a nation, not to any one of the circumstances here suggested, but to all of them conjointly.

The territory of Portugal is in point of fact a huge fortress whose enceinte is constituted by ranges of mountains in the north and in the east, and by the sea on its western and southern frontiers; but no fortress is safe from attack and capture unless the garrison is adequate, and the Portuguese have shown themselves at all times of their history, from the first forlorn hope of their uprising, under Sertorius, against the Romans, a people apt for freedom and strong and stout in opposing foreign domination.

The country is indeed hard of access, but not inaccessible, as has been proved in every age of its history, and, compared to almost any part of Spain, its fertility, the amenity of its climate, and the richness of its soil have invited invasion. There is nothing in Portugal resembling the vast, arid, sunburnt, central tableland which constitutes nine-tenths of the neighboring country. The whole kingdom, sloping from the frontier mountains to the sea, forms a succession of fertile valleys interspersed with rich alluvial plains, watered by innumerable rivers, streams, brooks, rivulets, and water-springs; the air, tempered by breezes from the sea and mountains, and made agreeable by wood and stream, is far more genial than that of the great Spanish tableland. It is a region that has been coveted by the dwellers on the barren Iberian uplands in an age when agricultural wealth was nearly the only wealth.

In the early days of savagedom this region was eagerly colonized by Rome, and, later on, seized and settled on by Gothic tribes from the north, and, after that, appropriated by the Mahometan Moors. It was against these latter, and against the several nations of Spain that were beginning to rise to power against the yoke of Islam, that the first effectual struggle for freedom was made by the

inhabitants of Portugal—a struggle that ended in the constitution of the nation which is now modern Portugal.

THE LIBERATOR OF PORTUGAL

It might have seemed at first a hopeless struggle against overwhelming and impossible odds, and that the issue of independence could only be reached by a miracle. When seeming miracles come to pass in human affairs they generally happen by the action of some heroic personage who is also a man of genius. So it was with Portugal, and her hero, a greater one by far than the nearly contemporary Cid, El Campeador, in Spain, was the conqueror Affonzo Henriquez. The deeds of this Portuguese warrior king are authentically recorded in the dry chronicles of three nationalities, and in geographical and historic events whose effects and consequences subsist to our day. The actions of the Spanish champion, a condottiere captain who fought for his own hand mainly, now with, now against the infidels, were internationally as fruitless as the victories in the Trojan war. They have left no trace in history; they are suspected, indeed, to be partly mythical; but the memory of them lives, and will live always, for they are recorded in one of the great epics of the world.

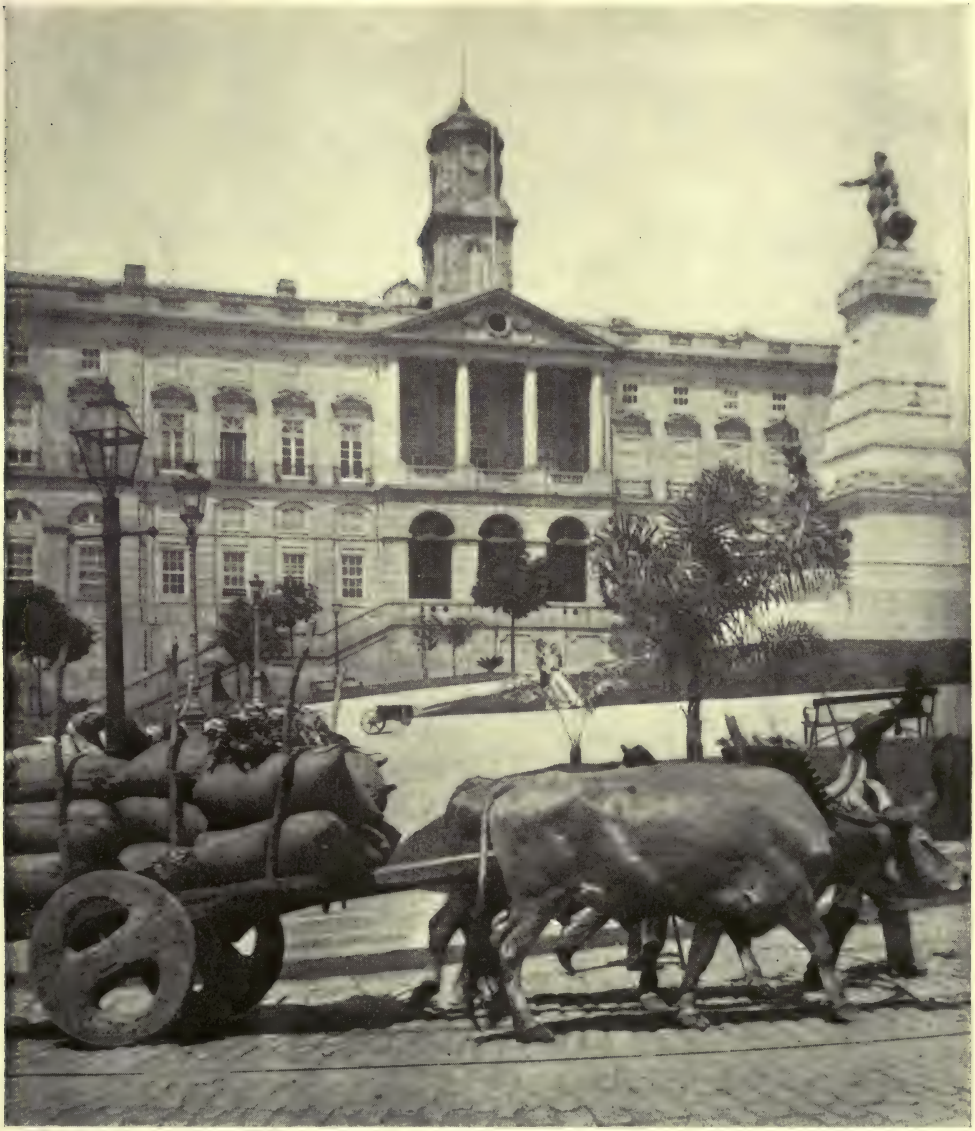
Portugal has had two great epochs during which the doings of its people were of international importance and have left their mark enduringly on the history of the world. The first, the long fight for freedom under King Affonzo Henriquez, nearly synchronized with the second and unsuccessful crusade and was indeed itself a crusade, for the Portuguese king and his people were fighting the battle of Christian Europe for the Cross as strenuously and as effectively, in Lusitania, as Godfrey de Bouillon and Richard Cœur de Lion fought for it in Syria. The news had come to northern Europe that a champion of the Faith was holding his own against the Crescent in Portugal, and when the king resolved to attack and besiege the central Moorish stronghold at Lisbon, he obtained the help of a large body of crusaders from North Germany and the low countries, who sailed for the East from the mouths of the Rhine and put in at Dartmouth.

The Cross prevailed in the end and Islam fell, and with it the Moslem power in Portugal. The conqueror spared the citizens of Lisbon. The religious fanaticism and intolerance that have marked later periods of Iberian history were then unknown, and the great Moorish city continued its prosperous existence under equal laws imposed by its Christian conqueror. Evidence of the humane tolerance of the Portuguese is clear to this day to any one who passes from any northern city of the kingdom to Lisbon. The type of the Lisbon crowds is still that of the dark Moorish race who dwell in Tangiers and Fez.

Affonzo Henriquez, king, patriot, conqueror, and legislator, the real maker of Portugal, was succeeded during the first century of Portuguese history by monarchs who followed in his footsteps and maintained his great traditions. This is the first and most glorious period in the history of Portugal, but there has been a second memorable epoch in which Portugal has stood forth prominent among the nations and done more than her share to advance the civilization of the world.

HER INTREPID EXPLORERS

This second great epoch was inaugurated by Prince Henry the Navigator, at Sagres, at the extreme southern end of Portugal. Prince Henry built an astronomical observatory, studied the then almost unknown art and science of navigation, and despatched exploring expeditions at his own cost into the unknown ocean to the south and to the west. He discovered Madeira and the Azores and explored the eastern coast of Africa as far south as Cape Boiador, in the tropics. Prince Henry's fame presently drew to Sagres, as to a college of the science of navigation, the sons of Portuguese nobles, who caught from him that spirit of maritime enterprise which during the succeeding centuries made Portugal one of the great colonizing nations of the world. The rare and difficult art of



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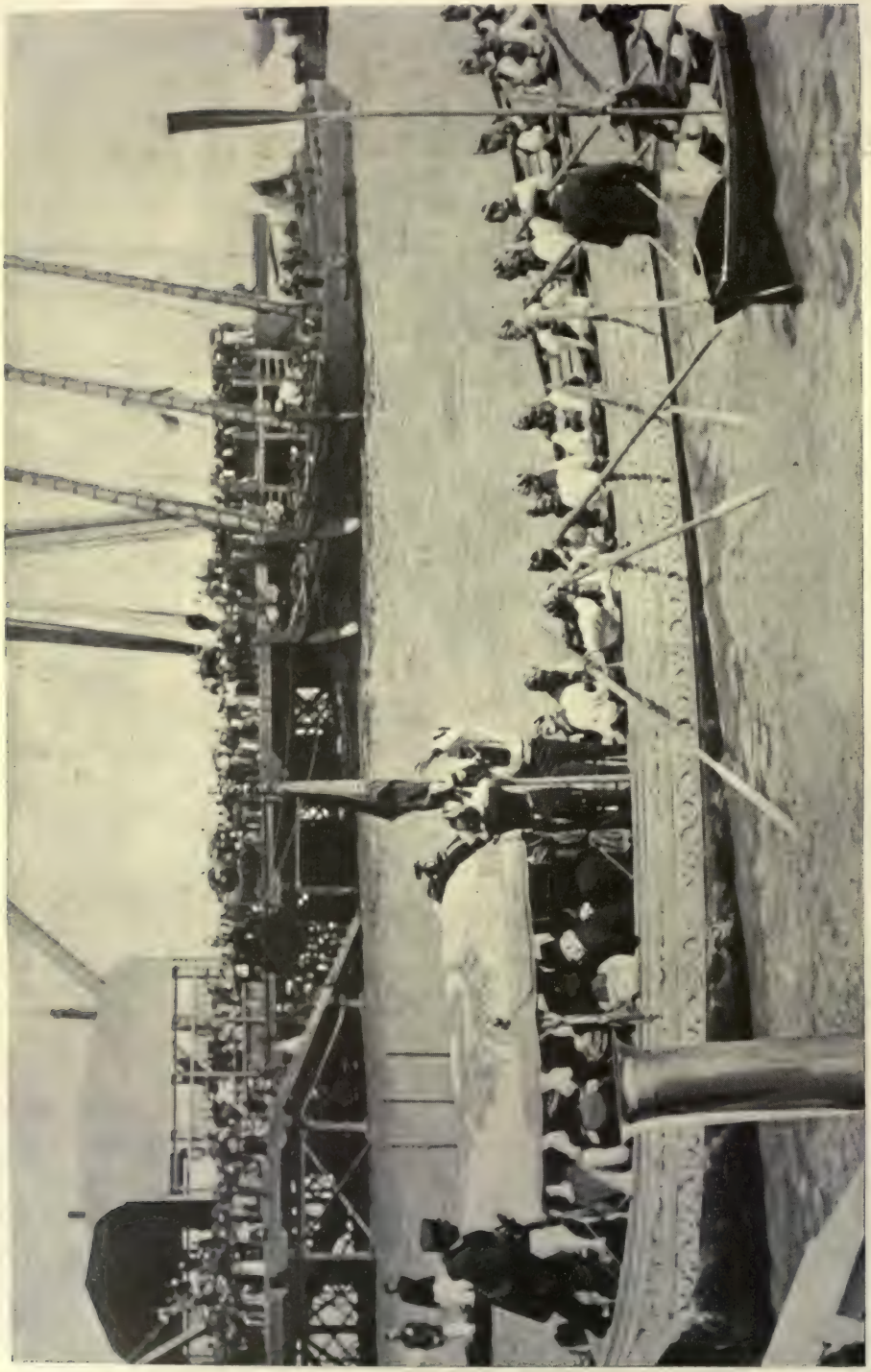
PRADA DE DOM AFFONZO HENRIQUEZ (SEE PAGE 868) AND STOCK EXCHANGE: OPORTO

Generally a foreigner speaking Spanish will be understood in Portugal; but a knowledge of Spanish, though enabling him to read Portuguese without difficulty, will not aid him much in understanding it when spoken, as the pronunciation of the two languages is radically different. The roads are usually very good, and open carriages with one or two horses can be hired in any town at an extremely reasonable price, $2.00 or $3.00 a day being ample for a carriage and two horses, which for the price will cover some five-and-twenty miles or more. The trains on Portuguese railways run primarily to convey goods and merchandise, and passengers must be content to wait while the goods are being loaded or discharged. The absence of vociferation in Portugal, which in a general way is a boon, is somewhat a drawback in railway traveling, as the names of the stations are not called out, and, as they are often painted inconspicuously, and are not visible from the carriage windows, it is necessary for strangers to be on the alert in order not to pass their station.—MARTIN HUME.



THE ROYAL BARGE AT LISBON

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THE FISHING FLEET ON THE TAGUS: LISBON

THE MONASTERY AT ALCOBACA

Built by Affonzo Henriquez, the liberator, to commemorate the Portuguese defeats of the Moors. The buildings are now used as barracks. The most striking objects in the Chapel of Tombs are two magnificent sarcophagi in florid decorated Gothic. The recumbent figures of king and queen upon them, as fair and perfect as the day they were sculptured, rest, not hand in hand as upon most similar tombs, but foot to foot. These are the sepulchers of Pedro the Just and Ines de Castro, for the faithful king ordered the body of himself and his beloved to be laid thus, so that when the universal trumpet should call him to arise, the first object upon which his reopened eyes should rest would be her, who, though unwed, was yet his wife through all eternity (see page 889).

colonization was not learnt in a day by Portugal, but it has never been forgotten. Other and wealthier nations have lost most of their oversea holdings, or keep them still with a rule so rigorous that it means servitude. The colonial kingdom of Portugal, under a wiser and more tolerant policy, has endured, not intact, indeed, but still a valuable and extensive kingdom beyond the seas.

The splendid example then set by Prince Henry the Navigator was followed by the Portuguese explorers and adventurers for nearly two centuries, and led to achievements and conquests of which the whole world is aware. It led to the great discoveries of Vasco da Gama, Pedro Cabral (the discoverer of Brazil), Amerigo Vespucci, and Magalhaes (Magellan) in the East and West Indies respectively, and to the conquests and tenure of part of India by Albuquerque; but these great triumphs must not diminish the fame of the man who first, in an age of comparative darkness, ignorance, and superstition, braved the terrors which the unknown seas then held for learned and simple alike.

Will this small nation ever again play a predominant part in the history of the world? In the modern race of the nations for wealth Portugal has established no record. It is still a small and agricultural nation, striving after industrial wealth which it has never attained and will never attain. It contains, however, in its most prosperous regions—the district lying immediately north and south of the River Douro—an object lesson in the prosperity of its yeoman farmers. This is a region where, by a slow struggle of the farmer against all the forces above him — feudal, ecclesiastic, and governmental—the small farmer has gradually won to independence and prosperity as a holder of the land. It would take more pages than this whole number contains to tell the full story of this struggle for existence and freedom which has ended in constituting a body of small yeoman farmers, their country's real strength, the like of whom is hardly to be found elsewhere.

A LAND OF YEOMEN

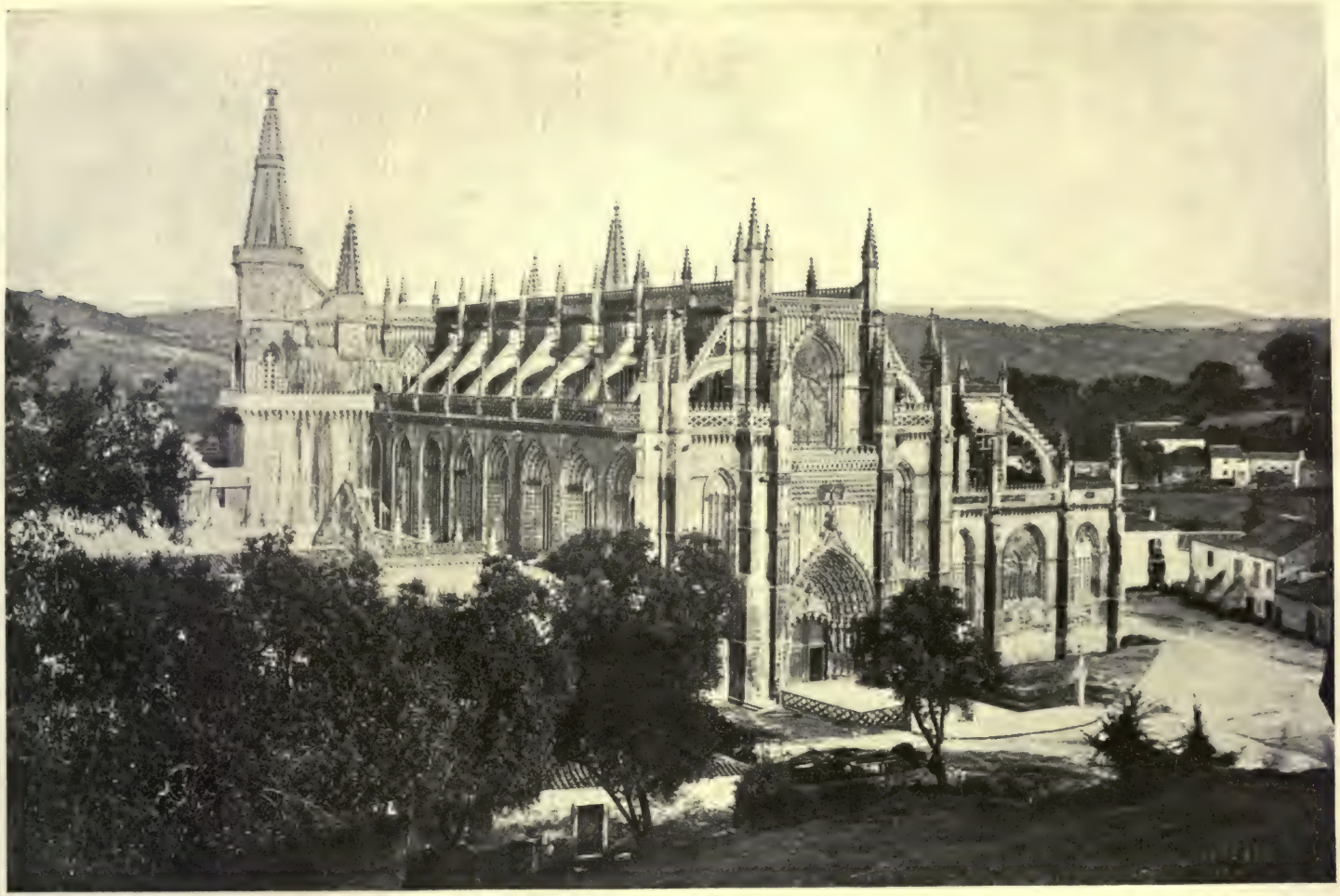
It was mainly from among this yeomanry that the regiments were recruited who fought side by side with our troops in the Peninsular War, whose hardiness and whose good pluck were the admiration of our men and officers, and of whom Wellington himself said that they were "the fighting cocks of the Peninsula."

The popular idea of Portugal, in my own experience, is that it is a sort of second-class Spain, the people lazy and idle, the language ugly and difficult, the literature poor. This report, absolutely and demonstrably false as it is, would be corroborated by most Spaniards. Neighbor nations seldom love each other. They seldom understand each other, and Spaniards and Portuguese are no exception. This attitude toward each other has been likened to that of two men sitting back to back on a bench who will neither turn nor speak to each other.

It is of course an error to consider either Spaniards or Portuguese as a single race. Galicians, Asturians, Aragonese, Castilians, and Andalusians differ among themselves as much as the man of northern Portugal from the dweller south of the Tagus. The difference in both countries is often as marked as that between Germans and Italians.

Portugal has been less written about than perhaps any country of its size and importance in Europe. The difficult Portuguese language has been a bar to the traveler and travel-writer.

Portugal is nearly the same now as it was ten, twenty, perhaps fifty years ago. It is an agricultural country, and in its most prosperous provinces it is a land of small proprietors, farmed by the holders themselves. I speak chiefly of the region north of the Tagus. On a 20-acre farm there can be no room for improved agricultural machinery, or for steam plows, reapers, or threshers. The land is mainly hilly, the fields are tiny and often built up into terraces by supporting walls, and their surface broken by the leaders and water channels that, in the



BATALHA, OR "BATTLE ABBEY," THE GLORY OF PORTUGAL

The wonder and envy of ecclesiastical architects for six centuries, and even now, dismantled as it is, one of the most beautiful Gothic structures in existence. The whole edifice is built of a marble-like limestone, which has turned to a beautiful soft yellowish cream color similar to that of an old Japanese ivory carving.

THE COURT AND ROYAL CLOISTERS OF BATALHA

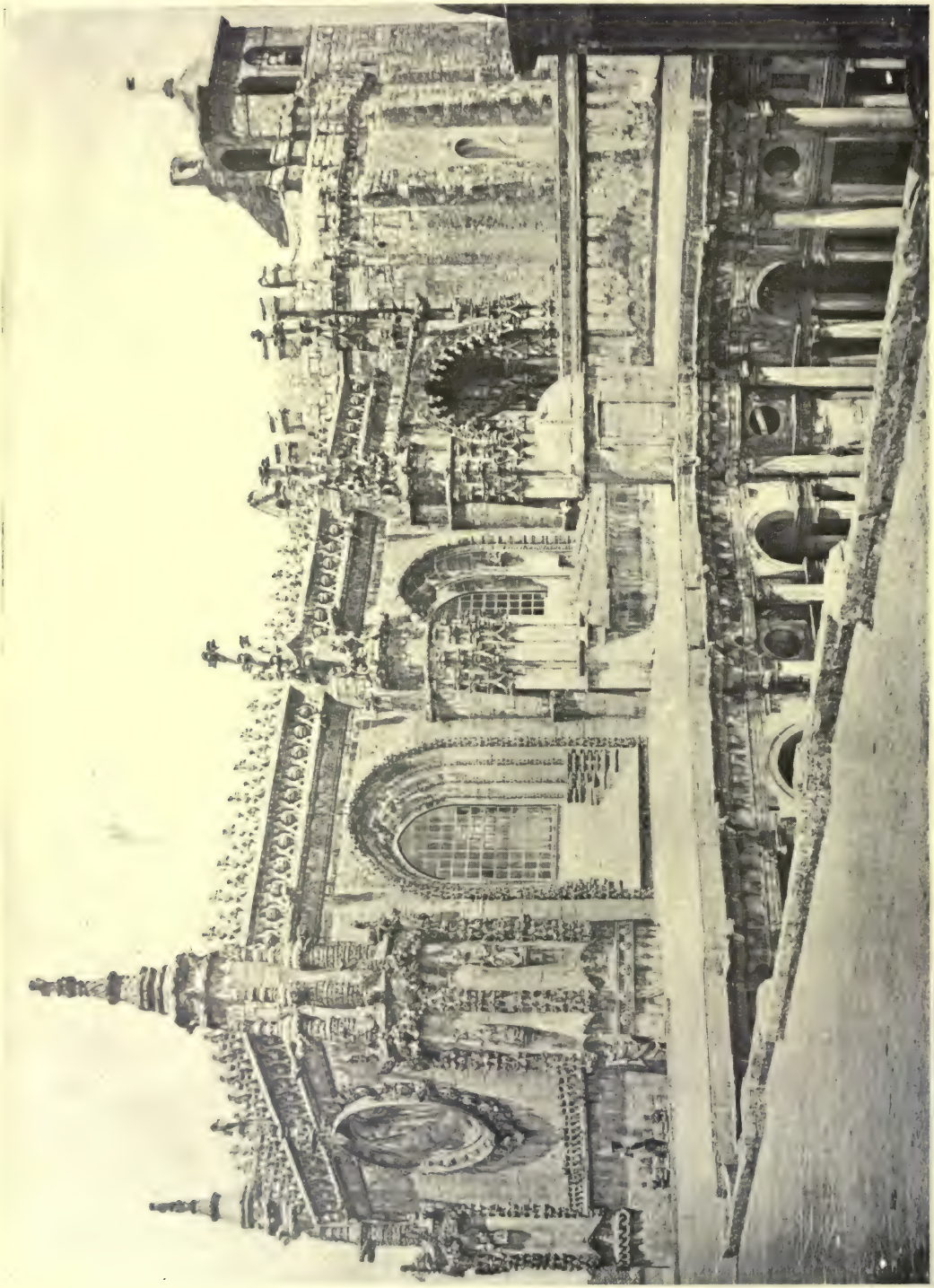
Standing in the center of the court-yard and looking up at the abbey, one sees three beautiful lace-like parapets rise one above the other along the whole length, on cloister, clerestory, and nave, clear-cut edges of perfect curves against the blue sky. Each of the cloister arches is filled with stone tracery of amazing richness and variety, the cross of the Order of Christ and the armillary sphere being deftly introduced in the fretwork with great effect. This cloister, like that of Belem, seems to mark the purer and less extravagant development of the Manueline style, in which the Gothic traditions have not been entirely cast aside, and only the most callous soul could remain unmoved by its exquisite beauty.—MARTIN HUME.

COURT AND CLOISTERS OF SAINT JEROME, AT BELEM

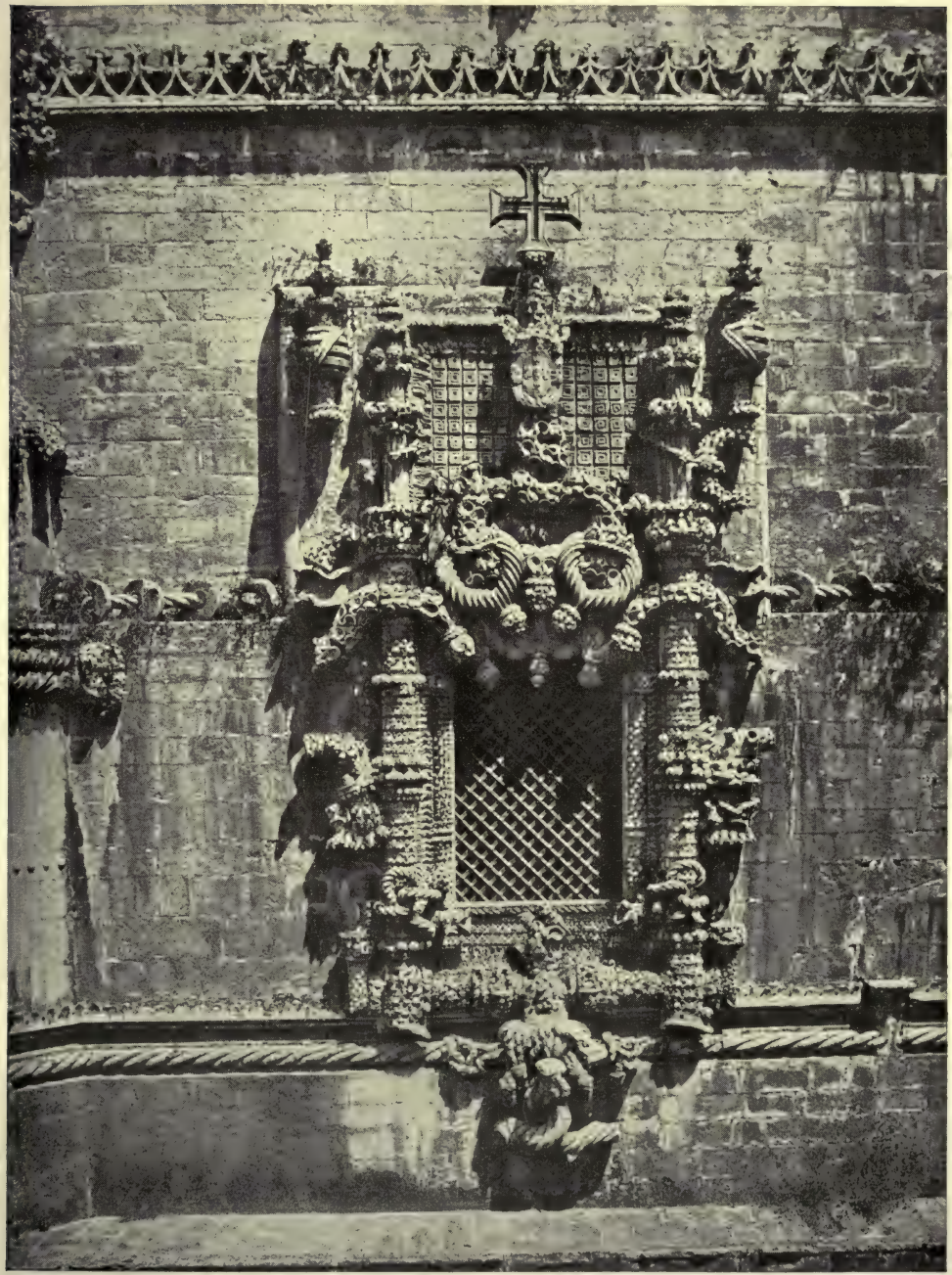
The monastery buildings of Belem shelter 1,200 orphan boys, who are there clothed, fed, and educated by the state, and it is a fine sight to witness them all at table in the great Manueline refectory of the vanished monks, and pleasant to hear the ringing of their youthful laughter as they play joyously in the stately cloisters.

THE PRINCIPAL GATE OF SAINT JEROME, BELEM, A SUBURB OF LISBON

This monastery and church was built by the kings of Portugal to commemorate the spot where Vasco da Gama landed on his return (1498) from his discovery of the first sea route to the Indies. In richness and complexity of ornament and statuary, the gate, windows, and entire building defy description. The structure is generally considered the best example of Gothic Manueline in Portugal. Vasco da Gama is buried here.



THE CHURCH AT THOMAR



A WINDOW OF THE CHAPEL: THOMAR

Thomar was the headquarters of the crusading knights of the Order of Christ, successors in Portugal of the Templars. The remains of the ancient fortress monastery, with its wealth of carving and exuberance of style, form one of the most remarkable sights in Europe.

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WHERE THE OLD AQUEDUCT CROSSES THE ALCANTARA VALLEY: LISBON

growing season, conduct the waters of irrigation to grass, roots, and cereal crops alike. The action of an improved Newcastle plow and a pair of 16-hand cart-horses on such cramped ground would resemble the gambols of a mad bull in a china-shop.

The Roman colonists in Portugal hit upon the most fitting implement wherewith to work such fields. It is represented on innumerable ancient bas-reliefs. The Roman plow, in its simpler form, is still the implement employed on the mountain farms of Portugal. It is drawn by the slow and amenable ox, who turns, stops, or goes forward at a word or a touch, and treads deliberately, feeling his way amid the gourds and watermelons that encumber every Portuguese stubble-field. This plow is little more than the crooked branch of some hardwood tree, cut from the nearest wood, of cornel or wild cherry, shod with iron and driven with a single stilt. It is so light that a man can lift it from the ground, and, when the day's work is done, the plowman slings it between the yokes of his oxen and thus illustrates that line of Virgil which must have puzzled many an English schoolboy:

Aspice aratra iugo referunt suspensa invenci.

All the operations of the farm, indeed, are conducted as the Romans conducted

them, except that maize has become a cereal crop in Portugal, ever since it was imported from Brazil by the Portuguese colonists of that country in the seventeenth century, and that the Portuguese have learned from the Moors the use of the eastern water-wheel to draw up the water of wells and low-lying rivers.

The vine is still trained to the poplar or the elm, as in ancient Italy, or run over lofty trellis-work, as it still continues to be in some other countries where the Romans have left their farm traditions. The wine is made today just as the Roman agricultural writers directed it to be made 2,000 years ago. The fermentation is still checked by the fumes of burning sulphur, as it was in Roman times, and the traveler who drinks the common wines of Portugal may be sure that he tastes the self-same liquor that Horace drank and sang of on his Sabine farm. There is but one difference: it was then preserved in earthen jars (amphoræ), and now in oaken barrels; but the Roman amphora, unchanged in shape and material, is still to be seen in rural Portugal. It is borne on the women's heads to carry water from every village well.

METHODS OF GOVERNMENT

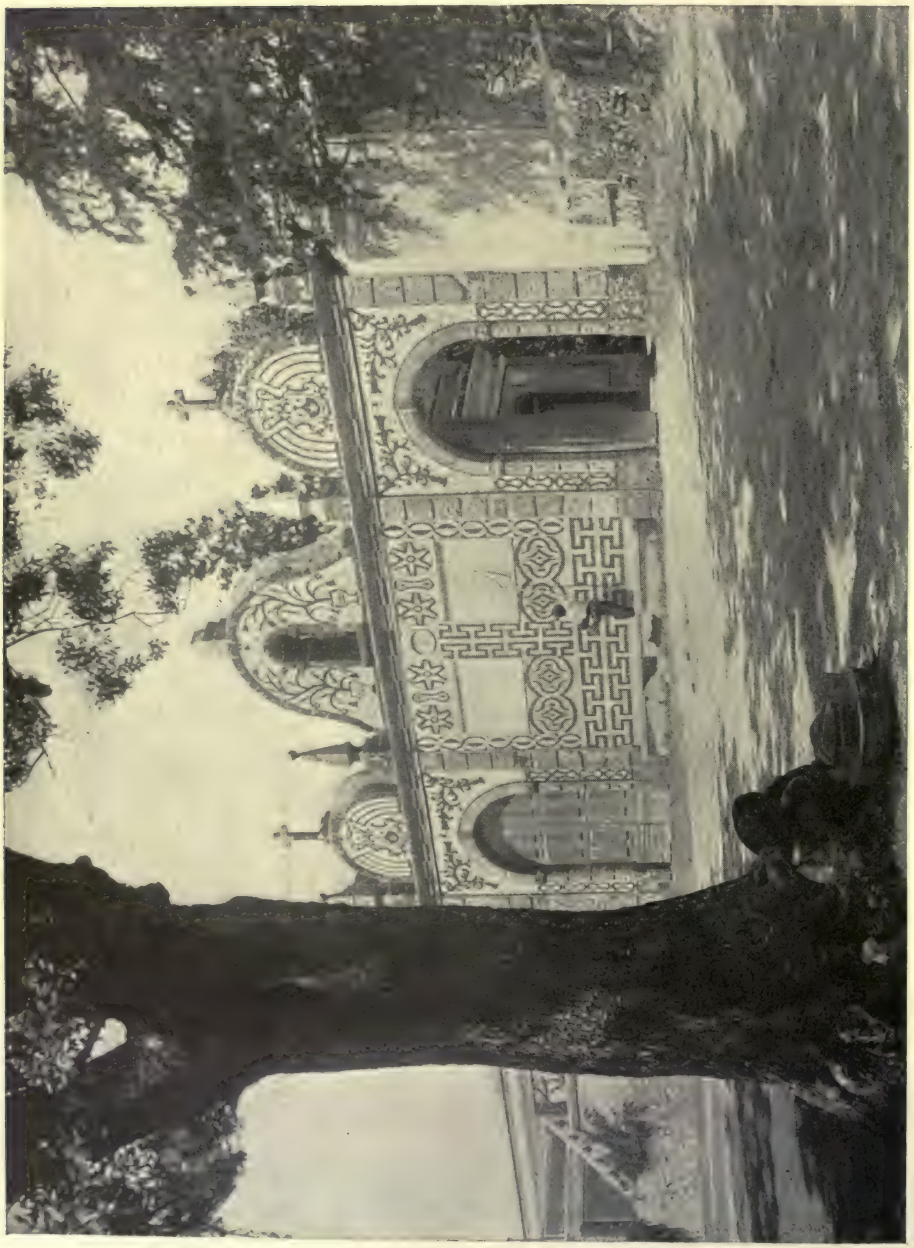
The Portuguese constitution, coming piece-meal to the country, is hardly 80 years old, and the best that can be said of it is that it took the place of very miserable methods of government, and that the Portuguese, being on the whole a shrewd and reasonable people, have made a better use of their constitution, under a line of wise and liberal monarchs, than could have been expected.

It cannot, however, be urged by the most friendly critic of the Portuguese people, that they have not been deplorably misgoverned. By common assent of the Portuguese themselves who are not active members of a political party, bribery, corruption, bad faith between governors and governed, and consequent maladministration are rife in every department of state. These facts have indeed become by-words among the people of all classes in the country. They are the topics of every-day talk in street and market-place.

The Portuguese, a wise, long-suffering people, have lived, have suffered, and have learned, too. Taking them as a whole, the Portuguese are perhaps the most unanimously patriotic people in the world. This great quality in them, existent from the remote past, is still strong, and will be sure to guide them to high issues in the future, as it has in the past. The welfare, the greatness, and the independence of their country is the end set vaguely in the mind of every self-respecting inhabitant of the country.

The modern Portuguese has somehow left his former eminence in the line of decorative art, and that he should have done so is one of the puzzles that modern Portugal presents. I will not attempt to solve it; I will only note that evidence of high artistic traditions meet the traveler everywhere. It is to be found abundantly in articles of domestic use made in Portugal two or three hundred years ago, in the fine repousé silver plate, in the faience from Portuguese kilns that have not been lighted for 300 years, in the inlaid cabinets known as Goa work, but mostly made in Portugal, and in the still more artistic cabinets, chests, tables, chairs, bedsteads, and domestic shrines of carved wood in good rococo style, worked in native chestnut or in rosewood imported from Brazil.

The now disestablished monasteries must have been rich in such work, for it is still to be found scattered in many a farmhouse. There is a still more persistent tradition of good art-work in the peasant gold jewelry to be seen on the necks and in the ears of every peasant woman on market and fair days, and on the counters of whole streets of jewelers' shops in Lisbon and Oporto. These fine-art forms derive from farther back than the plate, pottery, and cabinet-work before mentioned. They are unchanged traditions from the days of the Moorish occupancy. There are, however, extant art traditions that go further back than to Moorish times. In northern Portugal



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THE ENTRANCE TO THE SACRED WOODS OF BUSACO

On the two stone tablets are carved the papal bull forbidding the approach of woman to its precincts (see page 886)

every ox-yoke is carved with a quaint and elaborate design, the home-work of the peasants themselves on long winter nights. The designs belong to a very early period and are distinctly Gothic in character.

THE PORTUGUESE LANGUAGE

In Portugal we are in a country where three distinct races have, in turn, taken the place of the autochthonous inhabitants, perhaps mingling their blood with, perhaps after extermination or expulsion of, the race on the soil. Three separate civilizations have, in historic times, lived, prospered, and left their abiding marks in the habits and customs of the people; probably also in the blood of the actual dwellers on the land, and very patently in the Portuguese language and its literature.

The Portuguese themselves like to boast that their language is nearer to Latin than any other derived from the mother tongue of the Romans. In proof of this they have composed poems and prose passages which are fair Portuguese and fair dog-Latin. That, however, goes for little. Every foreign student of Portuguese knows that it is easy to read, it is harder to learn, harder to pronounce, and harder to understand when spoken than any other of the Latin languages. The reason is that Portuguese has borrowed very much from the Arabic word, phrase, and idiom. It has perhaps also got from the Moors some sort of Oriental uncouthness, and certainly some use of strange diphthongs which the unpracticed tongue finds it hard to pronounce. Yet it is a rich and flexible language, standing by itself, as a literary vehicle, just as French and German stand by themselves.

THE WOODS AND GARDENS OF PORTUGAL*

By Martin Hume

WHEN I opened my shutters as the dawn was breaking the next morning, and stepped out upon the wide battlements of the castle, the scene before me was so wonderful as to force from me an involuntary prayer of praise and thankfulness to God that so much of beauty should be vouchsafed to my senses. Below and around me for miles on all sides stretched the woods—woods such as I have seen nowhere else in Europe. Great palms and towering cedars of Lebanon grow side by side with oaks of giant bulk; oranges and fig trees, cork and acacia, maple, birch, and willow stand beneath the straight eucalyptus, "tall as the mast of some great admiral;" araucarias spread their spiny branches with a luxuriance never seen at home, and mosses, ivy, and ferns clothe thickly every inch of ground, every bank, and even the time-worn stones, that all around testify to the existence of dwelling here long before the white palace raised its tall tower over the darkening wood of Busaco.

Beyond the trees the shadow of twilight still lingered in the valleys and the horizon was veiled in mist, but already the sun was touching the mountain-tops all around. One range after another caught the golden light, and as far as the vision reached mountain succeeded mountain like mighty waves suddenly stayed in their onward sweep and turned into rosy rock. Here and there amidst the greenery, far below upon the plains, a white cottage, or the clustered red roofs of a village, lit up the picture with a note of emphasis, and the sweet, cool air of the mountains, fresh with the scent of pine, eucalyptus, and wild flowers innumerable, came to the jaded town-dweller like a foretaste of some exquisite

* From "Through Portugal," by Martin Hume. Doubleday, Page & Co. 1908.

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THE LITTLE OLD CARMELITE MONASTERY AND THE BEAUTIFUL NEW UNFINISHED PALACE: BUSACO, PORTUGAL

new sense to endow mankind in a fuller life to come.

Straight before me, as I stood upon the battlements looking toward the south, there rose, as it seemed, quite close a steep mountain slope clothed with a mass of verdure so thick as to look like a solid billowy surface of every tint of green, from tender primrose to deepest bronze. Here and there a straight pine or cedar, more lofty than its fellows, caught with its feathery top a glinting sun-ray and held it, whilst high up, almost overhead, upon a rocky spur emerg-

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ONE OF THE LITTLE HERMITAGES WHICH DOT THE SACRED WOODS OF BUSACO
(SEE BELOW)

ing from the foliage, there stood a humble hermitage, and on the very summit, looking so inaccessible that no human foot could reach it, a little white tower of another hermitage reared its cross over all.

On the right hand, as one looked down over the battlements, the pretty gardens of the palace, with flowers and palms, are spread at the foot, whilst, resting humbly under the shadow of the palace, is the ancient church and the tiny monastery which for centuries housed the silent Trappists, whose loving care made this holy wood to grow upon the spurs and glens of a granite mountain. Beyond

the garden the wood slopes suddenly down in billows of greenery, and then at its foot spreads the vast plain, with towns and villages nestling in its hollows. And as the sun grows in brightness, I see beyond the limits of the plain, far away, a long strip of white, and over it, high up, as it seems, above the horizon, a deep violet wall. It is the sea, the broad Atlantic, with its fringe of silvery sand many miles distant, and it gives the supreme touch to a scene of perfect beauty.

On the other side of the castle the view is just as lovely in a different way. Beyond the palms and flowers at the foot, seen over a hundred carved crockets and capricious stone pinnacles and gargoyles, with the great tower of the castle and its armillary sphere over all, is a far stretch of undulating wood, and then a vast tumble of mountains, range over range, all but the highest clothed to the top with forests, and beyond and above them all the bare granite peaks of the Caramulo range, iridescent now with the morning sun. The domain occupies the whole of the northwestern end of a long, continuous mountain ridge, some eight miles in total length, running from southeast to northwest, and extremely precipitous on all sides.

From the earliest times, at all events since the fourth century, the glens and ravines that score these slopes have been jealously guarded by ecclesiastical masters.

The sheltered position and soft westerly breezes from the Atlantic endowed the spot with a climate mild, equable, and healthful, even for Portugal, whilst the purity and abundance of the springs and the marvelous fertility of the soil in the deep, moist gorges on the mountain-side made it an enviable place of secluded residence. Whilst the minimum winter temperature is about 40 degrees, frost being unknown, the summer heat is tempered by the altitude of the place and by the abundant shade of the woods, so that the temperature rarely exceeds that of a warm July day in England.

With these climatic conditions, it is natural that this end of the ridge, protected on all sides, should develop a vegetation of extraordinary luxuriance. So remarkably was this the case, that the successive ecclesiastical bodies to which it belonged for fifteen hundred years decreed that the woods were forever to be held sacred as a place of sanctuary and devotion. From the eleventh century onward the domain belonged to the Archbishops of Braga, and in 1626 one of them granted it to the order of shoeless Carmelites as a retreat remote from the world, where the monks following the strict Trappist rule might meditate in silence, undisturbed by the turmoil of their fellow-men.

In poverty, and with the hard labor of their own hands, the monks built the little monastery and humble church as they now stand, with other portions since demolished, and, year by year, for two hundred years, planted and tended with devout care the sacred wood which was their one earthly concern. From all quarters of the globe where the Portuguese flag waved, from India, South America, and the Far East, rare plants and trees were sent by Carmelites to their beloved "Matto de Busaco." Medicinal herbs, rare and lovely ferns, and exotic fruit and flowers, impossible in other places in Europe, here grew luxuriantly, and the silent, white-robed gardeners planted and tended their domain until it became, not a wood, but a sylvan garden of surpassing beauty, as it remains today.

A high wall shuts it in from the rest of the world, whilst a special Bull of Urban VIII, deeply cut to this day upon a great slab on the principal gateway, condemned to major excommunication any person who violated the sanctuary or injured any plant within the sacred precincts; and another papal Bull bans any woman who dares to set her foot upon the domain. Beautiful terraced paths were cut upon the hillsides, and, zigzagging down the ravines, fountains that gushed spontaneously from the mossy rocks were dedicated to saints and adorned with sculptured shrines or rustic grottoes.

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TYPES IN COIMBRA (SEE PAGE 889)

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ON A STREET CORNER: OPORTO, PORTUGAL

Everything that single-hearted toil and devotional spirit could do, for centuries the shoeless Carmelites did for their remote monastery and the fairy glens of Busaco, and since the abolition of the monastic orders in Portugal, the government have tended and guarded the spot as carefully as the silent monks before them.

As one trod the old path of the pilgrimage, up mossy steps and past despoiled shrines, with glimpses of sunlit glades and shady green dells, it was impossible to shut away from one's thoughts those generations of silent, white-clad figures who, shoeless, had toiled so often up the Via Dolorosa, with tears of penitence, perhaps agonies of regret, for the life from which they had fled. All around were relics of their unrecorded labor. Sculptured stones, chapels, hermitages, fountains, grottoes, and shrines were all built by their patient hands; paths scarped on steep hillsides, seats placed in quiet nooks for the meditative and weary; nay, the trees and plants from all lands growing so proudly now, had all been tended anxiously by the same dumb shadows that for centuries waited for death within the walls enclosing the sacred wood. If ever a place was haunted by sad, harmless ghosts,

these paths of pilgrimage at Busaco must still be thronged by the white-robed phantoms of those who made them.

From Busaco our road to Coimbra lay downward for a mile or two, through a beautiful country of pines and gorgeous stretches of purple heather in full bloom, and here and there long trellised vineyards, with the red bronze of the vine leaves adding a splash of color to the scene.

Patient ox teams toil along, led by small boys in black nightcaps, gravely courteous to the stranger, and black-eyed solemn children play soberly by the wayside and take no heed. Soon we pass through the big, poor-looking village of Pampilhosa, and leave the pines and heather behind us, for here down in the valley olives, cork trees, ilex, and vines abound, with figs, pears, and apples, in orchards nestled round the white cottages. Aloe hedges, with the big, fleshy lancet leaves of silver-gray, show that we are in a sub-tropical land, and patches of succulent sugar-cane for cattle fodder grow brilliantly green against the maize and millet fields, whilst all along the wayside the light-leafed poplars rear their straight shafts, heavily burdened by masses of purple grapes and flaming vine leaves, the only sign of autumn, though October is now upon us.

As we near Coimbra, though it is not much past noon, we met many groups of handsome country women, with, as usual, heavy burdens upon their heads, returning home from the weekly market in the city. Barefooted they go invariably, with their fine, broad shoulders, full bosoms, classical faces, and broad, low brows, their gay kerchiefs on head and bosom, and their fine eyes gazing straight forth with modest dignity, and mentally I deny assent to the boast of Guimaraes that its maids and matrons reign supreme in buxom grace, for those of Coimbra need bow the head to none on earth.

Coimbra is crowded with memories of the heroic times, of combats with the Moors, and of deeds of violence and blood perpetrated within its walls, and in its quaint crowded streets are corners that can hardly have changed since the Affonsos and Sanchos here held their court.

THE TRAGEDY OF INES

The heat was oppressive on the morning after my arrival at Coimbra, but a pilgrimage to the shrine of Saint Isabel the Queen, and to the shrine of love near to it, could not be foregone. Crossing the bridge, I first wended my way to a beautiful villa almost on the banks of the river, in whose grounds there stands the gothic ruin of a palace, and adjoining it, gushing from a rock shaded by dark cedars, a copious spring leaps joyously along a stone channel of some twenty feet long into a stone tank covered with water lilies.

It is a lovely, tranquil spot, where no sound reaches but the rustling of leaves and the gurgling of crystal water, and yet here, tradition says, was enacted in the long ago one of those tragedies that inspire poets, painters, and dramatists for all time. It was in 1355, and Ines de Castro, the lovely mistress of the Prince Dom Pedro, had so infatuated him that he refused to marry another at his father's bidding. The king, Alfonso IV, incensed at the recalcitrancy of his heir, caused Ines to be done to death here beside the "Fountain of Love" by three courtiers.

The son, Dom Pedro, rose in rebellion, and saw his father no more; but when, two years afterwards, the king died and Pedro succeeded him, he worked his ghastly revenge upon those who had persecuted his beloved. Ines had been buried at Santa Clara, the convent near to which this estate belonged, and now her body was disinterred, dressed in royal robes, crowned with a diadem and adorned with jewels, and placed, a crumbling corpse, thus arrayed, upon a throne in the monastery-church of Alcobaca, whilst all the courtiers, upon their knees, kissed the dead hand of her whom they had insulted and contemned in life.

"The fountain of love in the garden of

THE ROYAL SUMMER PALACE AT CINTRA, NEAR LISBON, "THE CASTLE OF PENHA"

Originally a Jeronomite monastery built by King Emmanuel to commemorate the voyage of Vasco da Gama (see page 894)

tears" is the spot called to this day, and a crumbling little gothic convent founded by the lover king between this and the river bears the name of "the convent of tears" (see illustration, p. 872).

Coimbra is famous as the seat of learning for all Portugal—for many centuries, and still, the only university town in the realm. The huge square bulk of the university buildings on the crest of the hill overlooking the town typify the absolute domination of the place by the academical tradition. The hotel on the Alameda, like other hostelries of its sort, has no lack of commercial customers, but even they, assertive as they are, are swamped by the university professors, staff, and graduates who flock to its tables for their meals, whilst in the streets bookshops jostle each other, all filled with text-books, and the unmistakable students are everywhere.

There was some stay at Pombal, where it was a feast day, and the peasant costumes were seen at their best—good, upstanding people these, gaily clad, sober, and orderly, coming to the railway stations in good time and unhurried, but not hours before the train starts, as the peasants do in Spain.

In the market, under the shadow of the great mediæval castle ruins on the hill, they do their buying and selling, livestock for the most part today, without vociferation, but with an earnest quietness which is as far as possible from depression. Here at Pombal, and at Albergaria, near, the men wear brown, undyed homespun jackets and trousers girt with red sashes. The bag cap is almost universal, and mutton-chop whiskers are the rule, but what will attract a foreign visitor most in their dress are the curious triple-caped ulsters, made of layers of grass, seen in many places in Portugal in wet weather, but especially in this neighborhood. These garments, bulky as they look, are not heavy, and are

THE ROYAL PALACE OF CINTRA

The strange-looking towers, commonly called "champagne-bottle chimneys," are the chimneys to the great fire places where oxen were roasted whole

an excellent protection against heavy rain.

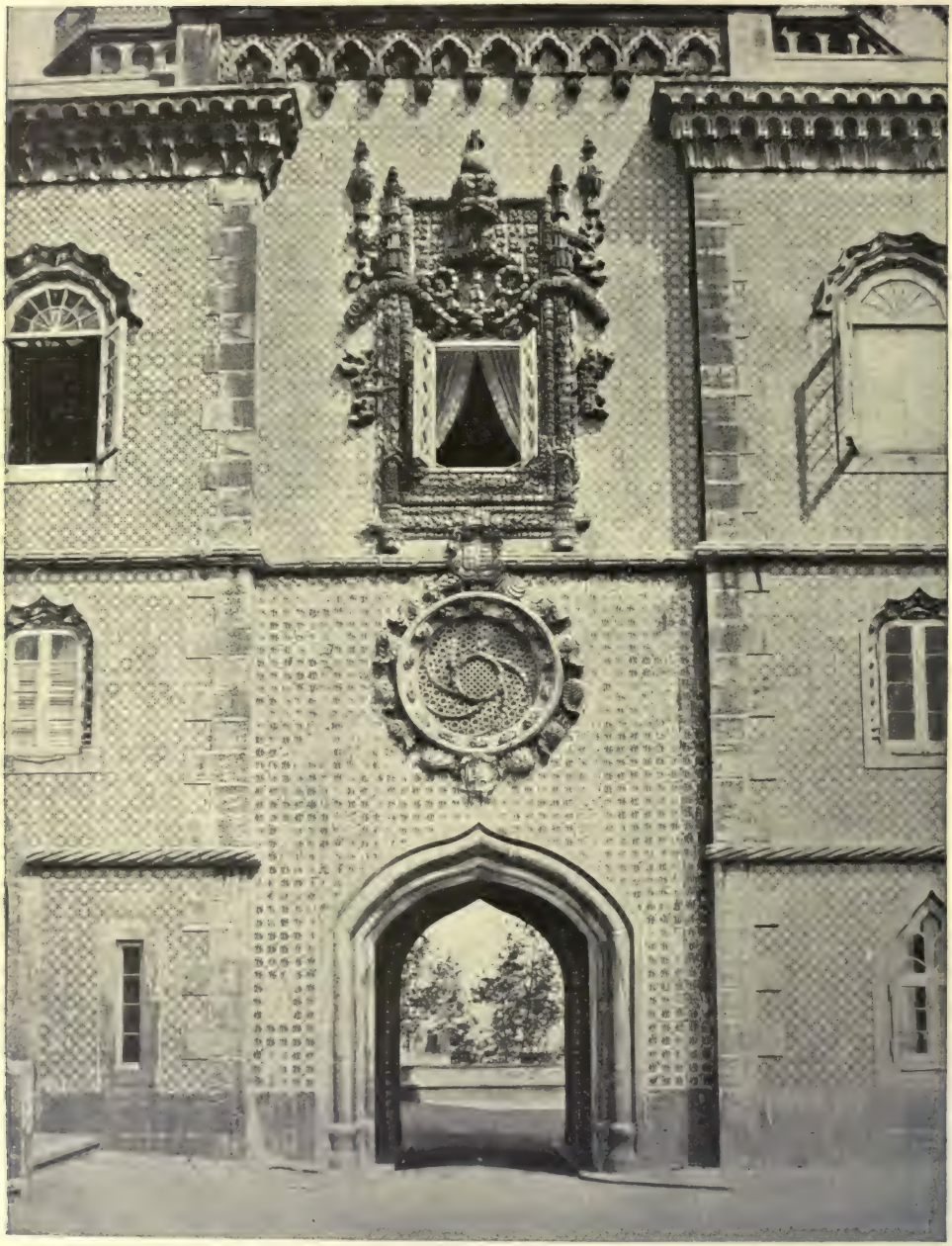
The women here have very full, short, gathered skirts, and though none of them wear shoes or stockings, hardly any are without heavy ancient jewelry of gold filigree, apparently of considerable value.*

The bodies of the dresses are mostly red or yellow, and a broad horizontal stripe of bright color often enlivens the skirt also, their brilliant head-kerchiefs being

* In this connection it is interesting to read the following quotation from "The Tourist in Portugal," by W. H. Harrison, published as long ago as 1839, by D. Appleton & Co.:

"It is not uncommon, in some of the provinces, to find women who have not a shoe to their feet, ornamented by necklaces of gold, some of them of great value. Mrs ——, the lady of a merchant of Oporto, related to us an odd anecdote of a servant whom she had obtained from the country. The girl entered upon her vocation with every appearance of being quite competent to its duties, as indeed she proved to be; but, to the great annoyance of the English prejudices of her mistress, she wore no shoes. The lady mentioned the circumstance to the girl as unusual in English families; but was answered by the domestic that she wore stockings, which was more than servants in the country did, and that she deemed that a sufficient concession to the fastidiousness of a foreigner.

"The lady perceiving that, independently of the want of shoes, the domestic's wardrobe was deficient in what her mistress judged to be very essential articles of dress, and conceiving that want of funds on the part of her new servant was the cause of their not being procured, kindly volunteered an advance on account of wages. The offer was, however, received with some marks of indignation by the domestic, who opened her box and displayed a wealth of jewelry, in the shape of gold necklaces, which quite astonished her mistress, and which was adduced as irrefragable proof that, if she was not provided with the articles that were deemed necessary to her equipcent, it was not for want of the means of purchasing them."



ENTRANCE TO THE SECOND COURT OF THE CASTLE OF PENHA: CINTRA

BALCONY AND PRINCIPAL GATE OF THE CASTLE OF PENHA: CINTRA

usually topped by a broad-brimmed velveteen hat, for the pork-pie hat of the north has been left behind now.

THE GREAT PALACE AT CINTRA

Like the similar mountain of Busaco, the "Rock of Lisbon" is scored by ravines and dells innumerable, sheltered valleys open to the soft sea-breezes charged with grateful moisture, and from time immemorial the luxuriance and variety of its vegetation have been proverbial. At a time when Lisbon, only some 15 miles away, is sweltering and breathless within its south-facing semicircle of hills, the slopes of the mountain of Cintra are fresh and invigorating, and some of its gardens are a veritable paradise all the year round.

The village of Cintra lies in one of the folds of the great hill, at perhaps a third of its height up the side.

Sheer aloft upon a precipice a thousand feet and more above its roofs there stretch the mighty battlements and massive keeps of a huge castle of fawn-colored stone—a castle so immense as to dwarf Thomar, Leiria, and even Obidos almost to insignificance. Long lines of crenellated walls following the dips and sinuosities of the crest of the peak appear to grow out of the mighty rounded boulders, some of these great masses of rock seeming to hang over perilously, as they must have done for thousands of years, top-heavy and threatening.

The fortress must have been impregnable by force, and indeed was only gained at last from the Moors by treason, the gate having been bought by the Christians from an unfaithful guardian. A narrow path cut on the face of the precipice is the only practicable approach to the fortress, and leads soon to yet another gate flanked by a strong tower built upon one vast, solid boulder. Yet another strong gate tower we pass through, and with a sudden turn we are inside the fortress, on the right of us a ruined chapel, once a mosque, and on the left a watch-tower, with, at its foot, a monument on which the cross is graven surmounting the crescent, emblematical of the fate of the adjoining chapel.

To describe in detail this prodigious ruin would be impossible in any reasonable space. The summit of the crag consists of two separate peaks at some distance from each other, the higher one occupied by the main keep, "the royal tower," and long battlemented walls reach from one point to the other, with bastions at intervals and massive square keeps at the salient angles. On all sides within the great enclosure formed by the battlements, covering the whole summit, remains of towers and buildings of various sorts are scattered amidst the dense growth of trees and brushwood that have intruded upon the space. The battlements are strong and perfect still, and it needs but little imagination to people them again with the turbaned and mailed warriors, sheltered snugly behind them, watching for the advancing hosts of the Christian king, certain that, so long as Islam was true to itself, no force could take this stronghold of their race.

Upon the highest point of the rock of Lisbon was King Manuel the Fortunate wont to linger for hours and days for many months together, climbing up from his palace in the town below, that he might gaze far out upon the Atlantic, watching and praying for the return of Vasco da Gama from his voyage to India round the African continent, the route that in two generations the impetus of Prince Henry the Navigator had opened.

There was but a tiny Jeronomite hermitage or penitentiary here in this savage eyrie to shelter the anxious king, and during his vigil he vowed that if the great explorer came home successful he would build upon the spot a worthy monastery of the order in memory of the event. The work must have been a prodigious one, for even now the place is hardly accessible by carriages, and the quantity and the weight of material necessarily brought from below was enormous.

This monastery, like the rest, was disestablished and secularized by the state in 1834, and King Ferdinand, the consort of the Queen of Portugal, and a first cousin of Queen Victoria and Prince Albert, bought the building for conversion into a royal palace.

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GLIMPSES OF KOREA AND CHINA

BY WILLIAM W. CHAPIN, OF ROCHESTER

With Photographs by the Author

KOREA, the little nation which has been so carefully watched by the Powers during the past few months as she has been undergoing the process of being taken over by her powerful neighbor, Japan, is, considering the rapidity of the changes through which she has passed within 30 years, a country of unusual interest. Comparatively little was known of her prior to 1882, as up to that year she was a hermit nation, satisfied with her own resources and conditions, only anxious to be left undisturbed. Indeed, previous to that date, it is said to have been death, not alone to the foreigner who landed on her shore, but to the native who gave him shelter.

A land so oriental, full of unusual scenes, and customs so strange, but recently opened to the safe inspection of foreigners, and withal so accessible to travelers in Japan, furnished considerations which impelled us to brave the perils of the Korea Strait and embark from Shimonoseki for Fusan.

Our ship was to sail at 9 in the evening, and the promptness after we boarded the steamer with which we sought our berths proved that the rumors which had come to us regarding the discomforts of the rough passage were thoroughly believed. On awakening several hours later, as we glanced from our porthole at the gentle rippling surface of the sea, sparkling in the glory of the full moon, a scene so at variance with the conditions we had expected, our first thought was that we were in a dream.

The long dock at which our steamer landed at Fusan was alive with people, most of them coolies, in white clothing and with long hair in an untidy coil, worn on top of their heads, waiting to transfer our baggage to the railway station, half a mile distant. This is done by means of peculiar racks carried on the back, in which not only baggage is borne, but every conceivable thing, even to live animals. Were the tourist to journey to Fusan alone, he would feel amply rewarded for visiting this gateway city, even if the crossing proved as rough as is sometimes experienced.

One can hardly realize that such a change of scene is possible after only 10 hours of steamboat travel: the people, their occupations and habitations, not to mention their wearing apparel, the dress of the men and the undress of some of the women—all being most remarkable. One of the attractions of this city is the

fish industry. The early morning catch is transferred to the docks, where the fish are sorted and disposed of either by sale or packing for shipment. In this work the native women take an active part.

In approaching the station we passed a section of the highway where grading was being done. The earth was first loosened by a queer implement—a hoe with long flat prongs—in the hands of men whose dusky forms were nude to the waist. Others were operating a three-manned shovel, a tool peculiar to this country, being a long-handled scoop from which two ropes extended. While the one holding the handle guides the implement, the two others furnish the power by pulling the ropes from a distance of about 12 feet. Judging from the results of their united efforts, it would require several to accomplish as much as could one able-bodied son of Italy, armed with an ordinary shovel and wheelbarrow.

The railroad of Korea, like most of those of Japan, is owned and operated by the Japanese government. The train which conveyed us northward much resembled those in our own land, and included a dining-car. The line follows for a long distance the course of the Raqutoka River, passing through several tunnels, some of which are of considerable length. The door-yards and houses seen from the car windows are surrounded by substantial stone walls, and, judging from the appearance of the numerous groups of children, tan-colored undressed kids were quite in style.

Before reaching the principal towns, train-boys passed through the cars informing each passenger that the train would stop so many minutes at the next station. On arrival, a rush was made by the passengers, mostly Japanese men and women, to the long wash benches at one side of the depot, which were provided with basins and running water. And the way they would souse their arms and faces, the men including their hair and necks, revealed a new trait in these little people.

Hot tea was furnished gratuitously and four times during the day was passed in cups on trays through the cars, to take the place of the ice-water tanks with which American coaches are equipped, for it is unsafe to drink unboiled water here as in Japan.

Along the route of the railroad, trees are very seldom seen and no apparent effort is being made to reforest; indeed, a tree in this country stands but little chance, even the branches to the smallest twigs being tied in bundles of uniform size, the roots, too, dug up, and all loaded on the backs of men or oxen, brought to market, and sold at so much per pound. A frequent object seen on the streets of Seoul is a mass of brush moving slowly along, it sometimes being difficult to determine by what motive power, so obscured is the animal by its load.

At a suburban station our car was entered by a nice-looking native, wearing the dress of the better class, who, in well-spoken English, solicited our patronage for the "Astor House," Seoul, Korea. At once visions of sumptuous repasts and faultless service enjoyed years since in lower Broadway arose in our minds and we decided to locate there. Upon inquiry we learned that the gentleman's name was "Sin Song," and that representing the hotel occupied his time only when he was not employed as courier for tourists; so, on the strength of appearances, his services were at once engaged for our entire stay, and we were most fortunate in our choice, as he proved satisfactory in every way. As an evidence of the enterprise of the young man, I will state that, although a Romanist, he was a member of the local Young Men's Christian Association, which has an attractive building and is in a prosperous condition.

Before visiting the points of interest in Seoul, which is the seat of government, let us consider briefly some facts pertaining to Korea as a country. Korea, although usually considered a peninsula, is in reality an island, 175 miles of its northern boundary being the River Yalu and the remainder the River Turnen, both of which are outlets of the same lake in the Northern Mountains, the

THE THREE-MAN SHOVEL: FUSAN, KOREA (SEE PAGE 896)

GRADING NEAR THE HIGHWAY: FUSAN, KOREA

KNEADING BREAD ON THE STREET: SEOUL, KOREA (SEE PAGE 902)

former flowing west and the latter east. The dimensions of Korea are about 135 by 600 miles, with an area, including its numerous small islands, of about 100,000 square miles—not far from the size of New York and Pennsylvania. The arable land comprises only about one-quarter of its surface, a range of exceedingly barren mountains and scantily clad hills extending its entire length. Its population, estimated from the number of houses on which taxes are paid, is 12,000,000, or 159 to each square mile. As a comparison, that of England is 500; Japan, 284; Germany, 250, and the United States 21. The climate is about the same as New York and Pennsylvania, excepting a season of six weeks of the wettest kind of rain.

Raising of rice is the chief occupation of the people, although Korea is said to be the fifth largest cotton-producing country in the world. In customs and looks the people resemble the Japanese in some ways, and although they have many noticeable peculiarities, laziness, as some writers have charged, is not one of them. Many varieties of fruit thrive and the country is rich in coal and nearly all mineral products.

White clothing is the emblem of mourning in Korea, as it is in Japan and China; the mourning period is three years. On the occasion of the death of a royal personage the entire population must put on white. This custom is said to be accountable for the people having adopted white clothing for ordinary wear, that they might be ready for the inevitable when it should come, either in their own or in the royal family.

The distinguishing feature in the clothing of the male Korean mourner is the material, which is unbleached linen or sackcloth bound at the waist with a rope girdle for the loss of a father, or one made of strips of cloth for a mother. In his hands the mourner holds a sackcloth screen about one foot square, with which to hide his face when passing along the

street. The mourning hat, while enormous, must be much more comfortable than the every-day fly-trap sort. It consists of a creation of straw and bamboo, shaped like a wooden chopping bowl, the edge of the rim being a coarse scallop, which distinguishes it from the one worn by peasants. The mourning hat as a setting for the solemn oval face of a Korean produces an appearance of extreme sadness.

The conventional clothing of the men is more striking than comfortable, as was demonstrated by my having a complete suit made to order. The foot is crowded into a cloth stocking not the shape of the member it is designed to fit, but, like the shoe, narrow at the toe and turned up to a point similar to a clown's foot covering. The dry-weather shoes, of coarse black cloth, low as slippers, their snug fit being depended upon to hold them in place, were found extremely uncomfortable.

The trousers consisted of a pair of pillow-cases having a wide waistband, not too uncomfortable in warm weather were there some other arrangement for holding them in place less confining than the narrow braid which is used as a belt. The padded waist is covered with a green silk waistcoat, the long unlined overgarment being of thin, gauzelike material, almost transparent, in a delicate blue, reaching below the knees. From the belt on the left side are hung two cases, one containing a small knife and a pair of chop-sticks, the other a pair of grotesque spectacles of smoked glass the size of silver dollars, set in a clumsy bone frame. On the right hang bags for money and tobacco. All of these cases are embroidered in bright colors.

In the hand is carried a plain fan, while the outfit is crowned by an absurd little pill-box hat, which, when worn by a native, is perched on a tightly-coiled queue and tied under the chin with a plain black tape, supplemented in the case of men of wealth or distinction by a chain constructed of two-inch pieces of the smallest-sized bamboo separated by amber beads, hanging from either side of the hat, under the chin and thence to the waist. The rim of the hat is of fine bamboo, while the upright part is of horsehair, so loosely braided as to expose the hair of the wearer to view. For rainy weather they have as a covering for the hat a peculiar round, helmet-shaped oil-skin, pointed at the top, which is drawn on and tied under the chin. When not in use this covering is folded in pleats like a fan and carried in the folds of the waistcoat.

The clothing of the wealthy Korean is of the same cut, but differs from the above simply in cost of the material; the coat being of silk and the hat of finer weave, the latter sometimes costing $20. The coolie and laboring element wear similar clothing in shape as those in the upper classes, but of a cheaper material and without waistcoat and over-garment. In place of the hat a head-cloth is sometimes worn covering the hair, the corners being turned upward above the forehead; most of them, however, wear only the queue coiled on top of the head.

The dress of the laboring class of women consists of a jacket or waist which extends about three inches below the armpits, while the skirt has only a tightly drawn band, thus exposing to view several inches of dark-brown skin between the waist and skirt-band. This condition seems more unaccountable, since women of the middle class never appear on the street without wearing a white skirt over the head and face in such a manner as to enable them to see their way without exposing even their faces to view, while others wear a green or red long-coat, hung in the same way and reaching to the knees; this garment, although having sleeves, is only worn as a veil. The higher, wealthy class of women never appear on the street except within the seclusion of the closely curtained chair borne by coolies.

In place of the street covering for the head, some of the reformers carry open umbrellas both in daylight and darkness, not as a protection from rain, but as a screen from the gaze of the naughty men. This seems rather amusing, since

THE WASHERWOMEN OF SEOUL, KOREA, WASHING IN THE SEWER (SEE PAGE 902)

THE BULLOCK—THE BEAST OF BURDEN OF KOREA

the purpose for which men carry fans is said to be to protect them from the eyes of the women. In their home life the women wear very bright, solid colors, without regard for harmony, waist, skirt, silk purse, and other ornaments being all at variance.

If a tourist flatters himself that he has escaped the lure of the curio dealer by crossing into Korea, he will soon discover it to be a case of jumping from the frying-pan into the fire, as some of the old brasses offered here at "ruinously low prices" are most attractive. Much of the work is crude and coarse, but when one sees the tools and the manner of handling them, the wonder is that such good results are obtained. The articles offered include oak chests and cabinets, almost entirely covered with brass plates, hinges, and trimmings. The former are locked with great padlocks of antique design, nearly as large as some of those seen on the gates of the walled cities. Braziers, vases, incense-burners, tea-kettles, and the high candlesticks peculiar to the country are among the smaller articles for sale. By exercising great care, our Sin Song secured for us a fine specimen of a cabinet and chest guaranteed antiques. As the stock of genuines is getting low, these wily craftsmen are offering recently manufactured close imitations of the old models, so the tourist without experienced assistance is at their mercy.

One of the first objects of interest we visited was the public park, an enclosure filled with fine trees, flowering shrubs, and roses in variety. It was such a place as would do credit to any country, with its well-kept lawns and tea-house of handsome outlines standing near the white marble pagoda. The latter structure is unlike those bearing the same name in Japan, being more the form of an octagon, with the shaft ornamented its entire length with carvings. It was erected 1,600 years ago as a monument to Buddha. In 1580 the top, comprising about one-quarter of the whole, fell, and now stands close beside the main part.

A few steps beyond and placed here at the same time is another monument, designed like an enormous turtle, the emblem of longevity. It is cut from one stone, bearing a tablet on its back. After a close examination it appeared so

well preserved that one of our party exclaimed that it did not look a day older than 1,599 years.

The main streets of Seoul are wide and well laid out. The stores generally are but one story, hardly deserving the title of buildings. On a pleasant day these thoroughfares present a very animated scene, the white clothing giving a prominence to each wearer, bringing him into view as far as the eye can reach. The means of conveyance over the roads, for the most part unpaved, is rickshaws drawn by boys who are swift and tireless. On one side of the main street were double tracks of a dilapidated horse-car line, which with the electric light and telegraph poles were evidence that intercourse with outside nations had not been without advantage.

The street scenes of Seoul offer great variety for the kodak, the burden-bearers of both sexes furnishing a constant change of scene; most of them being willing victims, entirely satisfied with a small tip. At the wood market on one side of the main street the patient steer is seen reclining under the weight of a load of logs which would cause a wagon to groan, and one wonders how he will ever regain his footing when his master makes a sale and the time comes to deliver the goods. These animals appear to thrive under their burden-bearing, being sleek and well kept.

At a turn of the road we encountered three coolies, each bearing a live pig, which must have weighed twice as much as the coolie himself.

The guardians of the peace were much in evidence, and in place of carrying the usual locust club they were armed with swords. Frequently one or more of these policemen were met preceded by from two to six culprits chained to each other by the waist, carrying tools for cleaning or repairing the streets, en route to some part of the city where they were to work.

The native bread of Seoul does not seem very attractive to foreigners after they have seen the process by which it is made. However, if its excellence was alone dependent on the thoroughness with which it is kneaded, the bread which "mother used to make" would suffer by comparison. After mixing, the dough is placed on a board in the road in front of the little bakeshop. Then two stalwart Koreans proceed to pound it with great beetles. It is not claimed that the quality of the bread is improved by the addition of impurities in the way of insects and dust which naturally result from the open-air treatment, but if one objects to eating it, a native will quote a proverb which, being interpreted, runs, "He who would enjoy his food should not look over the kitchen wall"—a maxim not without force in countries occidental.

The poor, neglected children seen on the streets and in the courts without a stitch of clothing to cover their dusky little bodies enlisted our sympathies. We recall one baby boy in particular to whom the accomplishment of walking alone was so new that he toddled with uncertain steps across the narrow road, and while attempting to gain the sidewalk rolled into the shallow ditch. Although in a decidedly soiled condition, he picked himself up and made his way toward where we were waiting to kodak a woman who was approaching bearing a basket on her head. The result was that they both reached the spot at the same instant that the bulb was pressed. We returned the youngster to his home with thanks.

The temples visited in the region of Seoul were found to be very ordinary and much neglected.

The occupation of laundress in this land, where the clothing of both men and women is white, of necessity employs large numbers of women. The seamstress, too, must have plenty to occupy her time, since most of the garments are taken apart at the seams before washing. Almost a daily sight was bevies of women lining both sides of small drains or sewers occupied in washing clothes. While not neglecting the object of the gathering, they were not unmindful of its social features, singing, chatting, and laughing to the accompaniment of the flat clubs, as they

PEASANT IN RAIN-COAT AND HAT: SEOUL, KOREA

CARRYING SWINE TO MARKET: KOREA

THE TIMBER MARKET: SEOUL, KOREA

POULTRY PEDDLER: SEOUL, KOREA

KOREAN COOLIES

(Showing racks for carrying baggage, as seen on arrival of ship at Fusan, Korea.)

KOREAN GE.

BUDDHIST NUNS: NEAR SEOUL, KOREA

A LOAD OF BOTTLES: SEOUL, KOREA

POTTERY CARRIER: SEOUL, KOREA

PEASANTS: SEOUL, KOREA
(Street scene.)

KOREAN CITIZENS: FUSAN, KOREA
(Group inside Municipal grounds.)

KOREAN COOLIES: FUSAN, KOREA
(Boys at the dock.)

BURDEN BEARERS: STREET OF SEOUL, KOREA

HIGH-CLASS WOMAN'S CHAIR: SEOUL, KOREA

FUNERAL CAR: SEOUL, KOREA

AS WE LOOK IN KOREAN GARB

KOREAN MOURNER
(Holding face-screen.)

THE WHITE BUDDHA: NEAR SEOUL, KOREA

GUIDE SIN SONG AND FAMILY
(Inside court; entrance to home. Group consists of Sin Song, wife, child, and wife's sister.)

ONE OF THE CITY GATES: SEOUL, KOREA
(Inside the city wall.)

KOREAN GENTLEMAN: SEOUL, KOREA
(Bargaining for pottery.)

ONE OF THE GATES OF SHANHAIKWAN: CHINA
(A corner of the city inside the wall.)

PRISONER WEARING CANGUE OR BOARD COLLAR:
SHANHAIKWAN, CHINA

CHINESE PRISONERS
(Exhibited on the street before being liberated.)

A BACK STREET: PEKING, CHINA

SYCHEE, PAPER SACRIFICE: CHINA
(Paper scrip for sacrifice in the temples.)

ENTRANCE TO CITY OF THE DEAD: CANTON, CHINA

MARBLE MANDARIN: CHINA
(One of the marble figures on road near Ming Tombs. Guide Chin on donkey.)

THE MANCHU FAMILY AIRING: PEKING, CHINA

MONGOLIAN CARAVAN: NANKOU PASS, CHINA

"PUZZLE PICTURE," NEAR MING TOMBS: CHINA
(How many passengers are being carried?)

MANCHU WOMEN: PEKING, CHINA
(Crossing road to dodge the kodak.)

CHINESE HIGH-CLASS FUNERAL: PEKING

WEDDING CHAIR OF GROOM: PEKING, CHINA

MANCHU WOMEN: PEKING, CHINA

pounded the wet garments placed on smooth stones. On one of these occasions, in the same stream a short distance from this jolly crowd, were others rinsing and trimming cabbages and other vegetables, preparing them for market. On the same sewer, a little farther on, was a poultry market, with numbers of crates of fowls, close to the water. We wondered how clothes could be made so white under such conditions.

The religious uplift of Korea has been almost phenomenal. Based on the latest reports of the results of missionary efforts, comparatively speaking, it leads the world. If the Christian workers whom it was our good fortune to meet in this field are indicative of the devotion and aggressiveness of the others, and if they are aided in the future by the more liberal support of Christians, which the past success of the work warrants, it seems reasonable to expect the wonderful results begun will continue beyond all precedence.

At the service which we attended in the Methodist Episcopal Church the edifice was filled to the doors. On one side of the center aisle sat the men in white, all wearing the peculiar little hats; the opposite side was occupied by women with heads uncovered, many of them gowned in different shades of green, with red waists or jackets. The space in front and at each side of the preacher, extending about ten feet, was filled with children, sitting on the floor. During the prayers the women turned in their seats and knelt.

In this church the curtain, which for years hung in the center aisle to shield the women from the scrutiny of the men, had been removed at their suggestion two years before. The pastor, a native, distantly related to the royal family, is said to be a very talented and forceful preacher.

A visit to the imperial palace, although unoccupied, was interesting. The buildings and grounds are extensive; a handsome pagoda standing on a small island is surrounded by a lotus pond, a wealth of trees adding to the beauty of the place. During the reign of the old emperor, his fear of assassination was so great that it is said 300 bed-rooms in the palace were kept constantly in readiness for him, no one knowing which one he would occupy on any night.

One of the most enjoyable trips from Seoul is by rickshaw past the Peking or Independent Gate through a picturesque road winding among the mountains. The construction of the great wall of Korea at this point appears a marvel of engineering skill, so seemingly inaccessible is this mountain fastness. Proceeding about two miles, we pass the water-gate, where the wall crosses the river and where in time of attack the iron gates in these great arches were let down to protect the city. The view of this crossing is one of the finest in Korea.

Another ride of three miles brings us to the White Buddha. In the solitude of this wilderness, far from the highway, close beside a clear mountain stream, stands a great granite boulder, on the face of which, carved in relief, is the sitting figure of Buddha. Above is a curved roof of the pagoda style, with elaborately carved cornice decorated in high colors. Every three years the outlines of the idol are given a coat of white paint, with a delicate moustache, ears, etc., in red to give it character. In front of the idol was a little shrine on which stood a lantern.

Enterprising shop-keepers in Seoul evinced their desire for English trade by signs, some of which were full of detail: "Handkerchief special occupation," "Copper, iron, lead and repaired store," "Broker for several kinds of manure," "Wild silk," "Cow meat," "Firm and without fade at bedyed for many colors," are self-explanatory.

Over a drugstore was, "Every medicine is required for small or wholesale," followed by the assurance that "all kinds of sickness must be examined or cured," while hanging in the window of a vacant building was the announcement, "To sell apply within next door."

The raincoat used by the Korean peasant and farmer is in shape a long cloak

BLIND STREET MUSICIANS: PEKING, CHINA

fastened around the neck, and is made of long straw, one layer overhanging another similar to a thatched roof, and is only effective when the wearer stands erect under the broad-brimmed hat.

The poultry peddler is a familiar object on the streets of this city, bearing his load of cackling merchandise in a cage on his back—a method of vending, to our minds, far more reassuring to the purchaser than holds among the Chinese, where dressed fowls are offered for sale, prepared by some process giving them the appearance of having fainted, so sickly white do they look.

The assassination of the beloved Queen of Korea by a Japanese in 1895 was an act which stirred this old sleepy nation to its foundation. Although her body was burned to conceal the crime, a small bone was recovered, for which a suitable place of interment had to be found. After the selection of several locations, upon one of which considerable labor was expended, all were abandoned for astrological objections. The astrologers, however, favored another spot, and, although this happened to be already occupied by a village, at great expense 1,000 acres were cleared of habitations, trees planted, an artificial hill 50 feet in height raised, and the small portion of her remains here buried in state. This assassination was one of the causes incident to the intense feeling of resentment which the Japanese met in their efforts to subjugate Korea.

How rapidly have events vital to Korea succeeded each other since the death of her Queen, in 1895 — the Chinese-Japanese and Russo-Japanese wars, followed by the assassination of Marquis Ito and other Japanese officials by Koreans, all tending toward the final extinction of this little nation as such. It is still a matter of considerable doubt as to the extent of benefit the change will prove. So far as revealed, Japan's intentions seem satisfactory to the powers and ultimately to the advantage of the people of the Mikado's new province, Cho-Sen.

CHINA

If a very high estimation be placed on Korea in point of unusual pictorial subjects, China's vast area of 43 times that of its little neighbor ranks still higher in the variety of its scenery, being a veritable paradise for kodakers. Although in certain localities there is some personal objection to being included in pictures, owing to superstition as to the

HAULING AN IMMENSE LOG

power of the evil eye with which the lens of the instrument is associated, it is but trivial.

Probably no part of the Dragon Empire can furnish such a stream of entertaining subjects as the great city of Peking, for on its site there has been a city 3,000 years, and it has been the seat of government since 1282. The present population is estimated at 1,500,000, and, although its massive wall 50 feet high describes a circumference of but 25 miles, the thickly populated suburbs close to the enclosure are fully as attractive.

Of all subjects we attempted to openly kodak in the city of Peking, the dainty, shy Manchu women were the most difficult. Naturally retiring, they seemed instinctively conscious of the presence of the camera, as a crow is said to smell the powder of the hunter, and so exhibited their timidity by running like a rabbit, dodging into doorways, where they would stay until the danger was passed. One would scarcely think they would object to a foreigner conveying their picture to their sisters on the opposite side of the globe, since they had spent so much time in arranging their hair on the peculiar-shaped thin boards, liberally applying cosmetic and vermilion on their faces and arraying themselves in their handsome gowns.

The mode of travel to the interior of China is on the back of a donkey or in the springless mandarin or Pekingese cart drawn by the same animal. During the trip to the Ming Tombs the snapshot was made which resulted in taking what proves to be a puzzle picture (see page 924). The umbrella was held low to prevent our taking the faces of the passengers, for if examined carefully a second person may be seen holding the umbrella.

One of the cheaper conveyances in Peking is the open Pekingese cart. It has a canvas covering extending from over the donkey's head to the back end of the vehicle. The most elaborate feature of the outfit is the fellies of the wheels, which are embellished with three rows of ornamental headed nails, giving the appearance of great strength. Although the jolting propensity makes these wagons most uncomfortable, nevertheless they are very popular and are frequently so filled with people that there is standing room only.

Peking is the Mecca toward which weary, burdened caravans wend their

A STEAM ROLLER IN THE AMERICAN SETTLEMENT AT SHANGHAI

way from distant boundaries of Mongolia, scores of them daily exchanging their valuable cargoes of the products of those lands for teas and other supplies.

The tired, dust-begrimed beasts in these trains seen entering the great city gates are not the gaily caparisoned, well-fed camels of the circus street-parade common to America. Owing to the exhausting heat of the sun, many of these caravans travel by night, the animals being relieved of their burdens in the morning for a few hours' rest, until the line of march is resumed at nightfall.

The occupation of mendicant street musician appears to be monopolized by the blind. From the sounds they produced on their strange, discordant instruments, we thought it would be much to their own advantage to be deaf also. The poor creatures were very numerous; while occasionally seen singly, they were more frequently met in twos or threes.

The method of street sprinkling in Peking is quite novel. A tub containing about one-half a barrel of water is carried by means of a pole run through the handle on either side. Two men carry this from the street-pump to the part of the road to be sprinkled. The pole is removed and one of the men, with the aid of a long-handled dipper, throws the water broadcast. This is an instance where "Chinese cheap labor" works in very advantageously.

Nothing in China will bear comparison, however, with what is known as the Great Wall. The very ancient city and provincial walls were connected more than 2,100 years ago. As an example of engineering skill, where is its equal? Its course, beginning in the sea, reaches an altitude of 10,000 feet, skirting the highest mountains and crossing the most inaccessible gorges. Considering it as a war measure, it is the most gigantic defensive work in the world. In extent it covers a length, according to recent investigations, of 2,550 miles. These facts alone would establish its claim to being classed near the top of the list of world wonders, without mentioning the wall as being the longest cemetery on earth, owing to the great mortality attending its construction, when the practice prevailed of burying the dead in the filled space between its outside retaining walls. Then we must not lose sight of the

STREET SPRINKLING: PEKING, CHINA (SEE PAGE 930)

claim some scientists have made that this serpent-like structure is the only object on the earth's surface which can be distinguished by our distant neighbors on the planet Mars.

Mr. Toole's account of the Great Wall, while humorous, contains some historical facts. He says: "The most important building in China is the Great Wall, built to keep the Tartars out. It was built at such enormous expense that the Chinese never got over it, but the Tartars did. The way they accomplished the feat was 'One went first and t'others went arter.' "

Wedding processions, always interesting in every land, are quite spectacular in China, and, like funeral pageants, are preceded by music, if the sounds produced by the pipers can be so termed. In the street procession the groom appears to have no part, his chair, borne by eight coolies, forming an independent parade.

The variety and splendor of funeral processions is one of the features of Peking. There is a Chinese proverb which reads, "The most important thing in life is to be buried well." If this implies being placed well underground, the conditions are not generally carried out, for in no country, according to our observation, were so many half-buried coffins seen as here; but if the reference is to pomp and extravagance, could the deceased have seen the displays it was our privilege to view they would have crawled back to their caskets to resume their long sleep with the consciousness that the purpose of their lives had been most satisfactorily achieved.

The city of the dead in Canton, South China, has storage capacity for 500 caskets. This silent city is made up of a great number of small one-story stone buildings, each house having two rooms of about 8 by 16 feet in size. A cumbrous coffin with the name of the deceased inscribed in Chinese characters on the foot occupies each room. The only other object in the room is a small shrine near the entrance, upon which light refreshments are placed. Here, amid the fragrance of smouldering incense, the spirit of the departed may daily enjoy a quiet cup of tea and a small cake, provided that surviving relatives continue to pay the expense.

THE GREAT WALL OF CHINA, WHICH DEFENDED THE NORTHERN FRONTIER OF CHINA FOR A DISTANCE ALMOST AS FAR AS FROM NEW YORK TO SAN FRANCISCO

THE GREAT WALL OF CHINA: UP ON THE MOUNTAINS

Some of the caskets in these receptacles were elegantly finished in highly polished lacquer and cost $1,000 each. The object of leaving the remains in this place is to insure the happiness of the one of the three spirits of the deceased supposed to remain in the bones by providing for it food, drink, and shelter.

One of the peculiar beliefs regarding the dead is that, if the soul of the deceased does not rest comfortably, the relatives will be correspondingly unhappy. The expense of storage and attendance often becomes very burdensome. We were told of an instance where the cost for the storage of the remains of a woman had used up the entire property of her husband, and that then the former servants of the family had voluntarily come forward and were then defraying the entire expense.

One of the minor penalties inflicted on a person convicted of crime is to lock the cangue, or board collar, on his neck, which he is sometimes compelled to wear several months. This implement of torture is constructed of boards 3 inches in thickness and 3 feet square, weighing from 30 to 100 pounds. In certain cases the culprit is chained on the street, and, with his offense written upon the cangue, is exposed daily to the view of passers-by. The victim is dependent on his friends, owing to the width of the collar, which prevents him from feeding himself.

While in the city of Shanhaikwan, and wishing to obtain a picture of one of these unfortunates, a prison was visited in company with an interpreter. The amount the jailer required for producing a prisoner wearing the collar seemed a little excessive. But when, according to the habit acquired in the shops of the country, an offer of one-half the price asked was made, the subject was at once forthcoming. The background of the picture includes the rack holding the staves for use in administering the punishment decreed by the magistrate, or for forcing a confession from an accused prisoner.

In some parts of China it is the custom to exhibit through the streets prisoners who have paid the penalty of their crimes and are about to be released. This permits the people to become familiar with their faces, so as to recognize them thereafter. In the case of serious offenses, one of the first acts of punishment administered to convicts is cutting off the queue, considered a mark of deep disgrace.

So unique are the methods of this old empire in the administration of justice that the entire subject is one of deep interest; for where the world over is such a vast population kept in orderly control by the minimum police and military force?

A tourist, when visiting Northern China, does not feel he has lived up to his opportunities if he neglects to visit the "Ming Tombs." The Ming rulers were the last strictly Chinese dynasty, which terminated about 500 years ago, when overthrown by the Manchus.

The burial place of these monarchs is located about 50 miles from Peking and 7 miles from Nankou. The only means of transportation from the latter place to the site is on the backs of the frisky donkeys or in sedan chairs.

The monotony of the several miles' ride by this slow manner of locomotion through the plains begins to tell on one when, as if to dispute the way, there loom up ahead an avenue of ghostly figures. On approaching, these are seen to be great stones which have taken on the forms of mammoth mandarins, lions, elephants, camels, unicorns, etc., to the number of 48, and stand on either side of the path about 300 feet apart. The effect of meeting these silent figures, which seem to gaze on one as he proceeds through the solitude of the lonely place, is quite impressive.

The accounts that travelers and writers give of conditions and experiences within this vast empire sometimes seem very conflicting. However, customs are so radically different in the several provinces that only a short visit is necessary to convince one of the probable truthfulness of the statements, as well as the fact that the half has not yet been told of this people, so wonderful, so ancient, and so unique.

A NEW SOURCE OF POWER

Billions of Tons of Lignite, Previously Thought Too Poor Coal for Commercial Use, Are Made Easily Available

By Guy Elliott Mitchell

Author of "Our Greatest Plant Food," "Our Coal Lands," Etc.

LIGNITE is a low grade of coal—the lowest and poorest in heat units, and only a step removed from peat and wood. The government coal geologists estimate that the deposits of this fuel in the United States exclusive of Alaska aggregate about 740 billion tons (740,000,000,000), of which fully one-third belongs to the public lands.

A few years ago it was not considered important whether there was much or little of this coal. It was good enough, perhaps, for the farmers to dig out a few loads and burn in their homes throughout the Great Plains region, where it is found; but it contained too few heat-units and too much moisture to generate steam under a boiler, so it was looked upon as of no industrial importance whatever.

Moreover, it would not bear transportation well, since it air-slacked and crumbled. A large part of the waving wheatfields of North Dakota were known to be underlain with lignite, but it was too young geologically, too poor in fixed carbon, to be of any great material use to the State or the Nation. Subjected to volcanic or other great earth pressures, or aged a couple of million years, it might become a second Pocahontas coal and attain great value commercially.

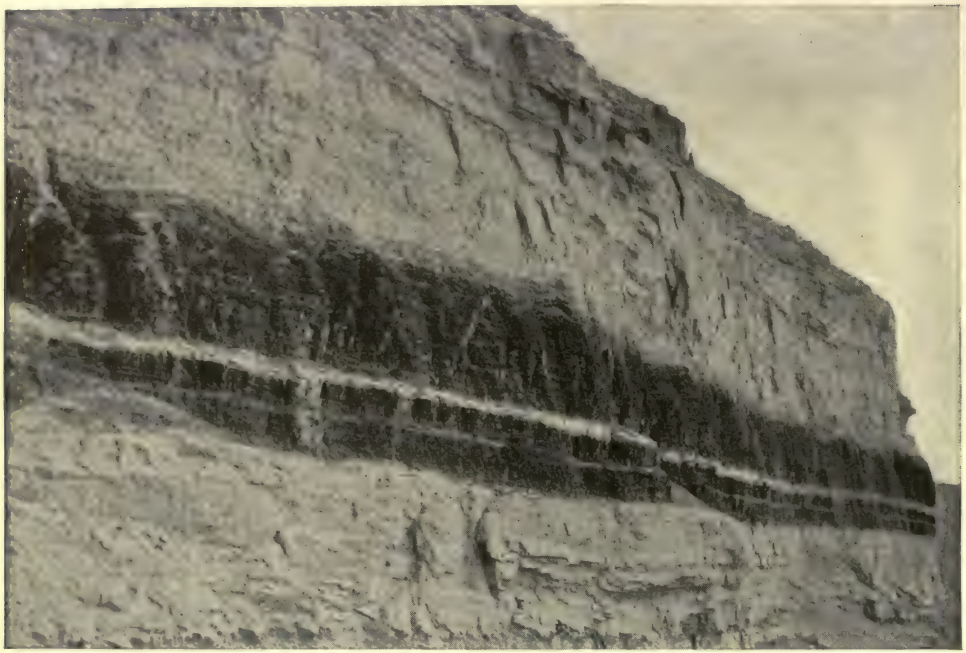
But the value of a thing is often a mere matter of knowledge concerning it. The Saint Louis World's Fair came along, an exposition of the products of the great territory acquired from Napoleon, and it was fitting that as a result the lignites of the Dakotas and Montana, parts of that wise purchase, should be demonstrated to have an incalculable potential value.

BY WHICH LIGNITE RIVALS OUR BEST COALS

The present director of the new Bureau of Mines, Dr Joseph A. Holmes, suggested the establishment of a government fuel-testing plant at the Saint Louis Exposition, under the Geological Survey, and one of the most important and far-reaching discoveries of the tests was that lignite, the useless, the despised, would do more actual work, turn more wheels of industry, ton for ton, if burned in a gas producer, than the highest grade, highest priced Pennsylvania or West Virginia coal fed into the best steam engine in existence.

The results of these tests are among the most remarkable of an age replete in wonders of discovery and invention. North Dakotans need not wait two million years nor pray for a volcanic convulsion to transform their lignite into coal; the lignite today has an industrial value which may yet turn many billowy grain fields into thriving manufacturing centers.

Plainly stated, these Geological Survey fuel tests showed that when coal is made into producer-gas and then used in a gas engine it has from two to three times the efficiency or driving power that it has when burned under a steam boiler in the ordinary way. The high-grade coals, too, were found to possess a greater efficiency when used in a gas engine, but the spectacular feature of the experiments was that vast stores of



AN 8-FOOT LIGNITE SEAM, NEAR GLENDIVE, MONTANA

lignite, which are entirely useless for steaming purposes and had previously been considered practically worthless, can be used most successfully in the gas producer.

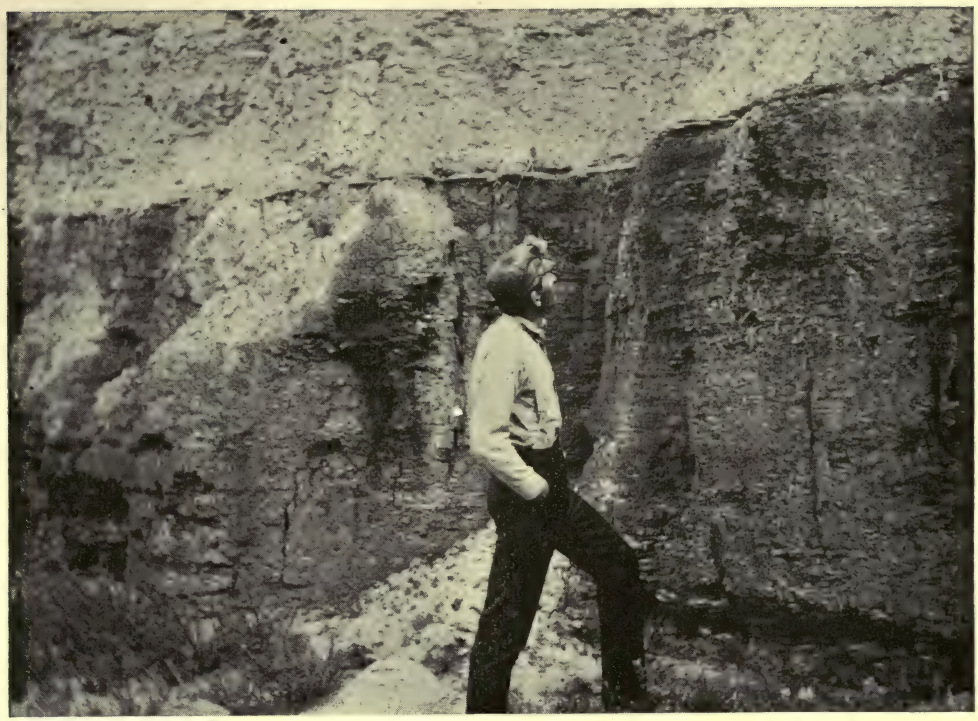
REMARKABLE WORK OF THE GAS ENGINE

Prof. Robert H. Fernald, late in charge of the producer-gas tests of the Geological Survey, made an estimate of the cost and operation of a small gas engine in comparison with that of a steam engine of the same horse-power, and also of two large engines, gas and steam, of the same horse-power. The figures are impressive. Professor Fernald gives the cost of a 600-horse-power gas plant at $48,000 and the steam plant at $40,000—$8,000 in favor of the steam plant. Operating both plants 300 days, 24 hours a day, the total cost for coal in the gas plant would be $3,680; in the steam plant, $8,250.

In a large plant, however, of 6,000 horse-power, he found no difference in cost between steam and gas plants. But, running these two plants continuously for one year, the gas plant would require but 21,000 tons of coal, which, at say $2.50 a ton, would be $52,500, while the steam plant would consume 42,000 tons of coal, at a cost of $105,000. The total operating expense and fixed charges of the 6,000-horse-power gas-producer plant are given at $141,775, while those of the 6,000-horse-power steam plant would cost $219,535—an annual saving of $77,580.

In offering the estimates, Professor Fernald declares that he has made the best possible showing for the steam engine, while that of the producer-gas plant is but a fair figure. In conclusion, he adds: "I believe that the producer-gas plant can better the figure given, but I doubt very much whether the steam-plant figure can be excelled, even if it can be reached."

Surely such savings of cost as these must appeal to the big manufacturers. That they do is shown by the fact that certain types of steam engines exhibited



A 9-FOOT LIGNITE SEAM, NEAR WILLISTON, NORTH DAKOTA

at the Saint Louis Fair as the very acme of steam-engine construction have since then been thrown onto the junk-heap and gas-producer plants substituted.

PRODUCER-GAS *vs.* STEAM PLANTS

In one of Professor Fernald's reports* a large number of most interesting comparisons are given, showing the relative efficiency of steam and gas plants in converting various grades of coal into electrical energy. Thus, of an Illinois coal from Springfield, it required 5.27 pounds to develop 1 horse-power in the steam plant as against only 1.79 pounds in the gas plant. Of an Indiana (Terre Haute) coal, it required 4.52 pounds in the steam plant against 1.61 pounds in the gas plant to develop 1 horse-power.

Most notable, however, were the results in the low-grade coals and lignites. Of a North Dakota lignite from Lehigh, 10 pounds were required in the steam plant to develop 1 horse-power, and only 2.82 pounds in the gas plant. With other lignites from Williston, North Dakota, Red Lodge, Montana, as well as several Texas lignites which proved absolutely worthless under the steam boiler, from 2½ to 3½ pounds developed 1 horse-power in the gas producer. Of 75 comparative tests made by the Geological Survey, the coals, when used in the gas plant, had from 2½ to 3½ times the driving power that they had in the steam plant.

In these tests the North Dakota and Texas lignites, and even Florida peat, yielded more power than did the very best Pennsylvania and West Virginia coals under the steam boiler.

HIGH VALUE OF THE LIGNITES

Commenting on the value of these tests, with special reference to the Dakota and Texas lignites, Professor Fernald remarks:

* Bulletin 416, United States Geological Survey, can be had upon application.

SEVEN FEET OF SOLID LIGNITE IN THE YELLOWSTONE RIVER BLUFFS, NEAR SIDNEY, MONTANA

"It should be noted that many fuels which give poor results under steam boilers have been used with great ease and efficiency in the gas producer, which thus makes it possible to utilize low-grade coals and lignites that have heretofore been regarded as practically useless. Several of the poorest grades of bituminous coals have shown remarkable efficiency in the gas producer, and lignites and peat have been used in it with great facility, thus opening the way to the introduction of cheap power in large districts that have thus far been commercially unimportant, owing to lack of industrial opportunities."

Although the gas producer is quite a new institution, the possibilities of this form of power and its ultimate future is indicated by the fact that there are already in the United States between 150 and 200 gas-producer installations, ranging in size from 1,500 to 9,000 horse-power.

The latest and perhaps most interesting phase of the development is the conversion into producer gas of the waste from blast furnaces. At the Gary steel plant, in Indiana, where the great blast furnaces run night and day, the fumes and waste which would otherwise belch from the huge chimneys to pollute the atmosphere are captured and converted into producer gas to the extent of creating 100,000 horse-power. This suggests the fact that with the producer-gas plant there is no smoke nuisance. The poorest, smokiest, smudgiest coal may be used, but there will be no smoke, because there are no smokestacks. The gas is generated in a producer which has no chimney and needs none. The coal is turned directly into gas, which goes straight to the engine.

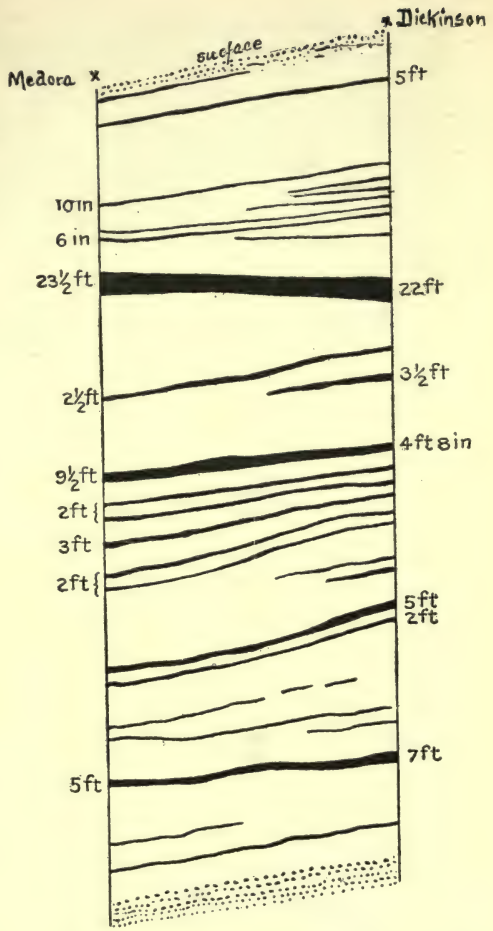
THE PASSING OF THE STEAM ENGINE

Really it seems as though we had come to the passing of the steam engine, the maker of civilization, and that the gas engine, the toy of yesterday, has loomed upon the industrial horizon and grown over-night into the giant of today. Its appearance means not only an eventual saving in the country's coal bill variously estimated at from $100,000,000 to $200,000,000 annually, but certainly a wider distribution of industrial enterprises.

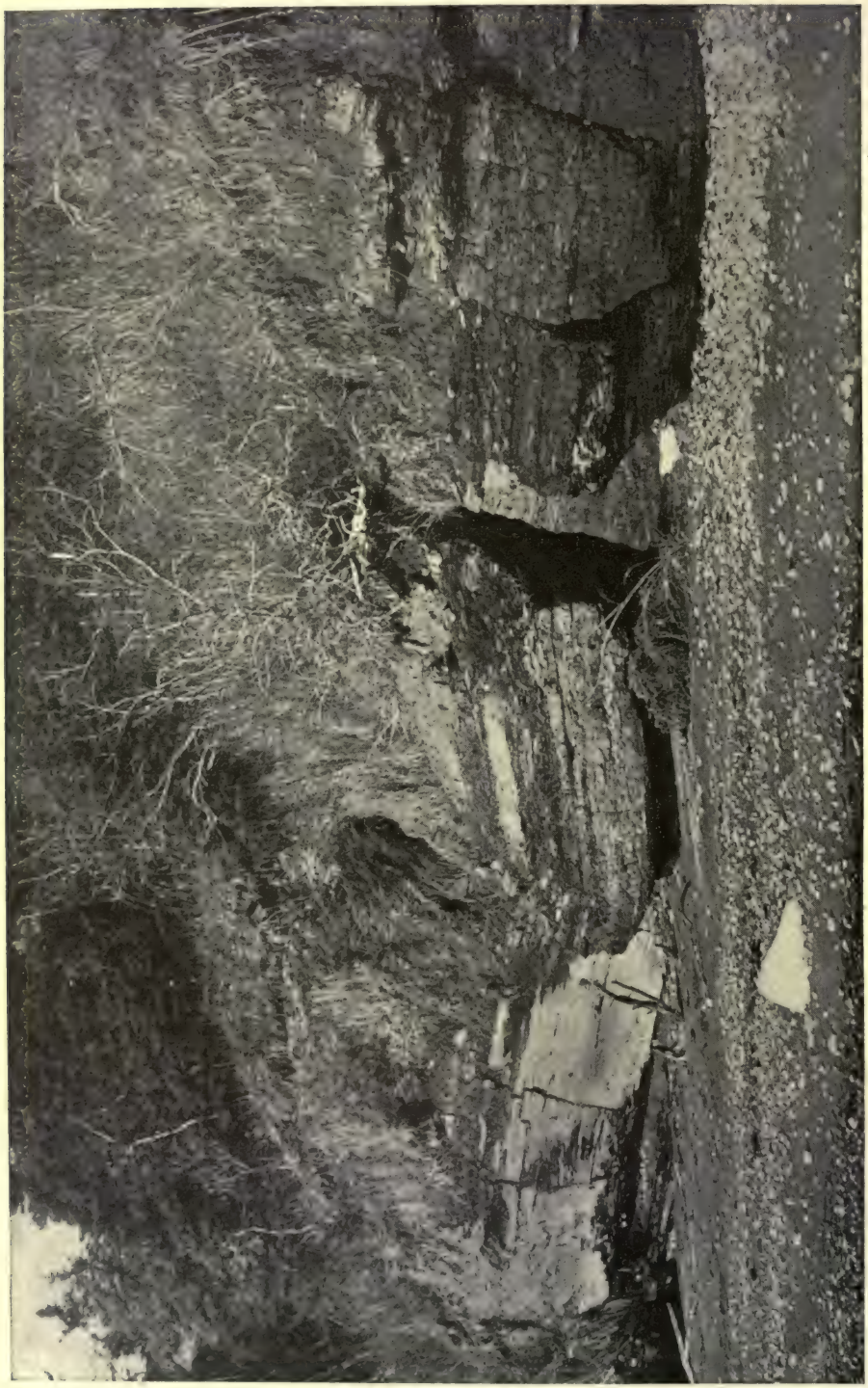
The great reduction in the cost of power production, made possible by the use of the gas producer, Professor Fernald says, means also rapid strides in electrical development within the next few years. Now that it is commercially possible to transmit electrical power for distances of 250 miles or more, the location of immense power plants using producer gas will speedily follow. A central plant could distribute such electric current for a distance of 500 miles; that is, 250 miles in all directions from the plant, thus covering a territory of probably 200,000 square miles—an area nearly four times the size of Illinois. With ten or a dozen of these great central plants located at the various coal-mining centers, the great railroads of the United States could send their trains speeding from the Atlantic to the Pacific Coast.

It would seem ridiculous to predict the immediate doom of the steam locomotive, Professor Fernald says; yet one of the officials of the New York Central Railroad has publicly stated that within 10 years, in his opinion, there will be no steam locomotives operating on the New York Central road. Already the New York Central has substituted electric for steam power on its lines from New York city to a point about 40 miles from the Grand Central Station, and it is rumored that before long electric trains will be running regularly on this road from New York to Buffalo.

These rapid changes are leading to one end—the centralization of power development and distribution. They point to the time, and at no distant day, Professor Fernald believes, when great central plants will be located at mine centers, and the electric power will be transmitted and distributed to railroads, industrial plants, cities, and the various institutions where electrical energy is needed. The great railroads will operate their trains by electricity, passengers and the country-side will be freed from the annoyance of smoke and cinders, while disastrous forest fires caused by sparks from locomotives will become a thing of the past.



An aggregate of 50 feet of Lignite Strata, lying between Dickinson and Medora, North Dakota, a distance of 40 miles.



A GOOD LIGNITE OUTCROP NEAR TYONEK, ALASKA

A LIGNITE LEDGE: KENAI PENINSULAR COAL-FIELD, ALASKA

ASTONISHING WASTE OF ENERGY IN STEAM PLANTS

From the standpoint of conservation, the producer-gas experiments and the rapidly increasing installations of gas-producing plants are notable advances. Stated in terms of wasted energy, the figures of fuel consumption become deeply impressive.

Incredible as it may seem, the fuel consumed in the ordinary manufacturing plant operated by steam power yields less than 5 per cent of its available energy in useful work; the other 95 per cent is wasted. The superintendent of motive power of the New York subway system, one of the most efficient steam plants in existence today, estimates the total losses in a year's operation of the plant at about 90 per cent—the utilized energy at only 10 per cent. As against this, it is estimated that a producer-gas plant operated on a similar scale would utilize over 21 per cent of the available energy in the fuel consumed.

Not only will the ultimate complete substitution in the United States of the gas engine entail a direct saving of millions of tons of coal annually, but, through the utilization of the lower-grade coals and lignites, which would otherwise never be mined, it will greatly lengthen the life of the high-grade coal deposits.

LIGNITE BRIQUETS

Another feature of interest in connection with the utilization of lignite is the briquetting tests started under the Geological Survey and now being carried on by the Bureau of Mines. Briquets from dust of ordinary coal make almost ideal fuel, but they are expensive to produce. The several per cent of "binder"—tar, pitch, etc.—necessary to make them cohesive runs up the cost. Lignite, however, can be briquetted without binding material; at least, this is done with some of the foreign lignites, and there seems no reason why American lignite as well should not make good briquets. The lig-

ALASKA LIGNITE COAL, EXPOSED FOR THREE YEARS TO WEATHERING AND SHOWING RESISTANCE

nite briquet machine which is being used in the government tests is a huge affair and simply exerts enormous pressure on the lignite, the constituency of which is such that a solid, dense briquet is formed, which makes an admirable fuel. Lignite, converted into cheap briquets, will keep indefinitely and bear transportation. The gas producer has made lignite a great possibility in industrial development; the briquetting machine promises to raise it into the class of a highly valuable domestic and heating fuel.

ENORMOUS LIGNITE AREAS AND TONNAGE

While the older coal fields of the Appalachian region may for some time lead in production, the advent and the continued improvement of the gas producer capable of utilizing the lower-grade fuels will have an important bearing on the distribution of industrial activities. With this feature in mind it will be of interest to inquire into the extent of these little-known lignite coals.

The latest field investigations of the United States Geological Survey show that North Dakota has an area of 31,240 square miles—19,993,600 acres—underlain with lignite. In much of the field there are several beds or seams, sometimes a dozen, one below the other. The tonnage of the State is placed at the stupendous total of 500,000,000,000 tons. As compared with this, the total tonnage estimated for the great coal fields of Pennsylvania, both anthracite and bituminous, is 112,500,000,000, and the importance of the advent of the gas producer is recognized when it is realized that every ton of the North Dakota coal has more driving power, utilized in the gas engine, than a ton of the very best of the Pennsylvania coal used in steam plants.

Montana will be a rich field for the gas plant, since she has an estimated 300,000,000,000 tonnage of lignite and low-grade bituminous coal, as well as some high-grade coal. In the San Juan field of New Mexico the Survey geologists estimate over 130,000,000,000 tons

of subbituminous coal, a grade above lignite and probably of little use for steaming purposes, but efficient in the gas producer. Texas has 23,000,000,000 tons of lignite, utterly worthless, according to the Survey tests, except in a gas plant, where it develops more energy than West Virginia's highest-grade coal. Even Louisiana and Mississippi, which are surely never thought of as coal States, have an area of over 16,000 square miles underlain with lignites. In considering some of these large coal areas, it is something of a shock to find that the great "coal trust," which owns the entire anthracite field in Pennsylvania, has only 480 square miles of coal land. On the coal map issued by the Geological Survey, this hard-coal field appears as an infinitesimal patch.

Summarizing the Geological Survey figures, the total area in the United States underlain by lignite and subbituminous coal—coal mostly of little if any value in steam plants, but of great efficiency in gas producers — is 246,245 square miles, or over 150,000,000 acres, and its tonnage is 1,393,423,000,000 short tons.

The tonnage of the lignite is calculated on the basis of about 1,800 tons per acre, one foot deep. Thus, if an acre is underlain with, say, two 4-foot seams, it will contain 14,400 tons of lignite. A square mile would contain 9,216,000 tons. In the tonnage estimates of the lignite fields, under the regulations of the Interior Department no account is taken of the deposits below 1,000 feet. If the estimates included the lignite found down to the 3,000-foot depth, as they do in the higher-grade coal, the tonnage would be immeasurably increased. It is interesting to note, in this connection, that the deepest mine in the world—in Belgium—in which coal is mined, approximately 4,000 feet below surface, is a lignite mine.

ALASKA'S LARGE LIGNITE DEPOSITS

Mention of Alaska's lignite deposits should not be omitted. About one-half of the Territory's coal is believed to be lignite, and, while there is not sufficient information upon which to base even an approximate estimate of the total tonnage of the various fields, it is probable that the reserve of lignite may be 500,000,000,000 or more tons.

To better comprehend the extent of this new resource, discovered in fact through the gas producer, the amount of coal already mined in the United States may be compared with the estimated reserves. Since mining first began the total amount of coal produced and the amount wasted in mining has been, to January 1, 1910, approximately 12,000,000,000 tons, which is a little more than one-half of what yet remains underground in the little 480 square miles of the anthracite field. The 1909 production was about 450,000,000 tons, with perhaps a recovery of 60 per cent—40 per cent being lost in mining—or a total exhaustion of 750,000,000 tons last year. This is just fifteen-hundredths of one per cent of North Dakota's easily accessible lignite.

VALUE OF PEAT

The improvement of the gas-producer plant has also brought into the field another natural resource heretofore considered of little if any fuel value, namely, peat. The knowledge of the area and tonnage of our peat deposits is incomplete; but they are very great, both in the United States and Alaska.

It is significant, too, that the regions in the United States that have peat beds of workable size and depth are found to lie almost entirely outside the territory in which the coal fields and supplies of other natural fuels are known to exist in abundance. The Geological Survey's estimate of twelve billion (12,000,000,000) tons of air-dry fuel as the product of the peat beds of the country, exclusive of Alaska, is believed to be an ultra-conservative one. Peat beds occur throughout Minnesota, Wisconsin, Michigan, New York, New England, New Jersey, Florida, in the eastern part of the Dakotas, barely infringing upon the lignite beds; northern Iowa, Illinois, Indiana, Ohio, Pennsylvania, Virginia,

North Carolina, South Carolina, and Georgia, and along the Pacific coast.

In Alaska no attempt has been made to estimate either the acreage or tonnage of peat. Professor Davis, the author of several Geological Survey reports on peat, states that the conditions throughout the greater part of Alaska favor the formation of peat, and he makes mention of many beds in the southern part of the Territory having a thickness of 15 or 20 feet. In the northern portion he speaks of peat beds 8 and 10 feet, and of others 30 and 40 feet deep which have been exposed by natural agencies. It seems evident, he says, that peat beds of workable extent are to be found in most parts of Alaska.

As a fuel for the making of producer gas, peat has an important place. In a country so marvelously endowed with wood, coal, petroleum, and natural gas, it has been assumed that peat has no place as a fuel, except in the far-distant future. However, inasmuch as transportation charges enter largely into the ultimate cost of fuels, and since peat is found in regions remote from other fuel supplies, it is coming to be recognized that its utilization may mean the establishment of manufacturing industries in many parts of the country at a distance from coal centers.

Like coal, peat varies in quality; but, of the tests made, some of it has been found the equal and even the superior of certain of the lignite coals, while in the gas producer it has developed more horse-power than the highest-grade coal in steam plants, ton per ton. Its theoretical heating value is between that of good wood and good coal. It carries from five-eighths to five-ninths the calorific value of the best bituminous coal.

KBOO, A LIBERIAN GAME

By G. N. Collins

OF THE multitude of intellectual games in vogue among civilized people, chess and draughts can alone be classed as games of pure skill, entirely free from chance. These are both supposed to have come to us from southern Asia.

A third game, equally free from chance, and, like chess, affording unlimited opportunity for the exercise of mental skill, is played over the whole of Africa and southern Asia, and by the negroes of the West Indies, but seems never to have been taken up by European races.

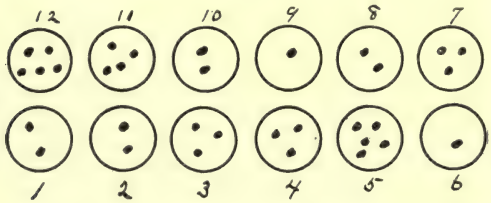
The game is most widely known by its Syrian name, *mancala*. A form of this, called *kboo*, or *boo*, is the only game of skill played by the Golah people of Liberia. Kboo is purely arithmetical, and it seems remarkable that natives who are unable to even give names to the numerals above 30 can excel in the intricate mental calculations of this game. The same man who was able to plan and execute a long series of complicated moves in this game would calculate the price for whip-sawing lumber by measuring only the width of the boards, disregarding their length.

The game as played by the natives of Liberia consists of a boat-shaped board (see figure on page 945), with 12 cup-shaped depressions arranged in two parallel rows of 6 each. The board in the writer's possession is made of some heavy dark wood, colored black and highly polished. The counters, or "men," are seeds of a leguminous plant, and are about the size of small kidney-beans.

The two players sit with the board placed crosswise between them, one row of holes being guarded by each player. At the beginning of the game each hole contains four seeds. To begin the play, one of the players takes all the seeds from any one of the holes on his side and drops one in each of the succeeding holes around the board, playing from

left to right, or counter-clockwise. His opponent does likewise, playing from any hole on his side. As soon as play commences, some holes are of course left empty and others receive more than the four seeds. In subsequent plays these empty holes will again receive one or more seeds.

One of the objects of the game is to play from such a hole that the last seed will fall in one of the holes on the opponent's side which contains either one or two seeds. When this occurs, the seeds in this hole, together with the seed dropped, are removed and count in favor of the player making the play. If any holes immediately preceding that from which such a "catch" is made contain one or two seeds, the whole series are also removed until a hole is reached that was either empty or contained more than two seeds. This play can be best explained by the following diagram:



If the player guarding the lower row of holes elects to play from hole number 5, the first of the five seeds would fall in hole number 6, the next in 7, and the last in 10. Since hole 10 contained two seeds, the three which it would contain after the play would be "caught," as well as the two in 9 and the three in number 8. The seeds in 7 would be safe, since they are more than two. Seeds can only be caught from an opponent's side.

The play continues until there are no seeds left on one or the other side when it is that player's turn to play. The game is then finished and all seeds remaining on the board count for the player on whose side they remain, and are added to those already caught. The player having the most seeds wins the game.

With skilled players the seeds caught during the game seldom play an important part, the principal effort being di-

THE BOAT-SHAPED BOARD USED IN THE LIBERIAN GAME KBOO
This game in slightly different forms is played over all Africa

Photo by G. N. Collins

GOLAH MEN PLAYING KBOO

Photo by G. N. Collins

Photo by G. N. Collins

GOLAH "HEADMAN," A SKILLFUL KBOO PLAYER AND AN INVETERATE GAMBLER

rected toward manipulating the play so that the seeds are accumulated on one side, leaving the other player with none. An important factor is the ability to properly estimate an opponent's skill; an elaborately planned campaign may be entirely frustrated by unexpected stupidity on the part of an opponent, as well as by superior skill.

The illustration on page 946 shows two natives playing this favorite game. The posture, which would be so uncomfortable to any European, is characteristic and perfectly comfortable for these natives.

On first acquaintance this game may seem childish, but as soon as a few games have been played the possibilities of strategy, feint, and decoy become apparent and the game will be found intensely interesting. The principle is entirely different from that of either draughts or chess, both of which depend on space relations, while kboo is entirely arithmetical. Although different forms of this game have been frequently described in technical publications,* no serious effort seems ever to have been made to introduce this African game among European people.

The Golah "headman," whose picture is shown on page 947, was the most skillful player I ever met. The long rainy season of Liberia afforded ample opportunity for practice, but as fast as the moves of my Golah adversary were mastered he inaugurated new methods, before which I was equally helpless.

* Lane, E. W.: Manners and Customs of the Modern Egyptians, p. 315.
Culin, S.: Mancala, The National Game of Africa. Report U. S. Nat. Mus. for 1894 (1896), p. 597.
Avelot, R.: Bull. Soc. d'Anth., Paris, 1906, pp. 267-271, and 1908, pp. 9-21.
Golberry: Fragment d'un voyage en Afrique. Paris, 1791, Vol. II, p. 480.

THE PEST OF ENGLISH SPARROWS*

By N. Dearborn

THE English sparrow among birds is comparable to the rat among mammals. It is cunning, destructive, and filthy. This sparrow was introduced into America about 60 years ago, and is now distributed generally over the eastern half of the United States and southern Canada and locally westward to the Pacific coast. This rapid increase is a result of the bird's hardiness, extraordinary fecundity, diversity of food, aggressive disposition, and almost complete immunity from natural enemies through its sagacity and its preference for thickly settled communities.

Its natural diet consists of seeds, but it eats a great variety of other foods. While much of its annual fare consists of waste material from the streets, in autumn and winter it consumes quantities of weed seed, and in summer numerous insects. Aside from the destruction of weed seed, there is very little to be said in the sparrow's favor.

It destroys small fruits, as cherries, grapes, pears, and peaches. It also destroys buds and flowers of cultivated trees, shrubs, and vines. In the garden it eats seeds as they ripen, and nips off tender young vegetables as they appear above ground, peas and lettuce being especially subject to attack. It damages wheat and other grains when newly sowed, ripening, and in shocks. It reduces the numbers of some of our most useful native species, such as bluebirds, house wrens, purple martins, tree swallows, cliff swallows, and barn swallows, by destroying the eggs and young and by usurping the nesting places. It at-

* Abstracted from "How to Destroy English Sparrows," by N. Dearborn. U. S. Department of Agriculture Farmers' Bulletin 383.

Photo from U. S. Department of Agriculture

ENGLISH SPARROW, MALE AND FEMALE, SHOWING THE MANNER IN WHICH THEY TAKE POSSESSION OF NESTING BOXES PROVIDED FOR NATIVE BIRDS

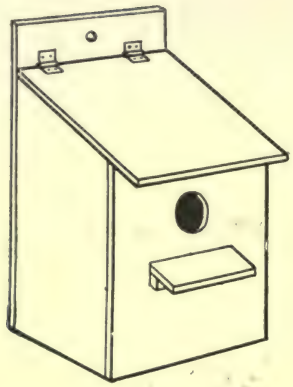
tacks other familiar native birds, as the robin, wren, red-eyed vireo, catbird, and mocking bird, causing them to desert parks and shady streets of towns. Unlike our native birds whose places it usurps, it has no song, but is noisy and vituperative. It defiles buildings and ornamental trees, shrubs, and vines with its excrement and with its bulky nests.

The evidence against the English sparrow is overwhelming, and the present unfriendly attitude of the public toward it is reflected in our State laws. Nowhere is it included among the birds that are protected. In response to frequent inquiries for means of abating the sparrow nuisance received by the United States Biological Survey, a few approved methods applicable to different conditions are here described.

Sparrows frequently give annoyance by roosting in ornamental vines and in crevices about buildings. If driven out late at night, several nights in succession, they will usually desert the roost. A jet of water from a garden hose is a potent disturber, particularly on frosty nights. Where water is not available, small Roman candles may be employed.

Though sparrows may be driven from a given neighborhood, the relief thus obtained is only temporary, and has the further objection that the nuisance is simply transferred elsewhere. More drastic action is therefore preferable.

The most effective method of prevent-



AN INEXPENSIVE NEST BOX FOR ENGLISH SPARROWS

ing the increase of sparrows in a locality is to destroy their nests at intervals of ten or twelve days throughout the breeding season. Occasionally they build large covered nests in trees, but as a rule they build open nests in bird-houses, electric-light hoods, cornices, water-spouts, and similar places. While it is often difficult to reach nests with the hand, they can usually be torn down by means of a long pole having an iron hook at the tip. By a concerted and continued movement to destroy every nest after the eggs are laid, English sparrows in any locality may be gradually reduced without resorting to shot or poison.

The sparrow's habit of nesting in cavities can be turned to account against it. By providing one-room bird-houses, or even packing boxes or tin cans, and putting them in trees or on poles or buildings at a height of about 10 feet, the birds may be captured after dark with the aid of a long-handled net. This net should have a deep bag and a small hoop made to fit the front of the boxes closely. After the net has been quietly placed over the entrance, a few raps on the box will send the tenant into it. Dilapidated buildings may sometimes be fitted up for catching sparrows in this way, as well as for destroying their nests and eggs. The figure on page 951 shows how this can be done. An ordinary wooden box may be nailed to the inside of the building over a hole made to admit the sparrows. The box should be arranged so that the top or upper part of the back can be lifted to gain access to the inside.

The box, also illustrated on this page, is designed to be hung on a building or a tree. Its floor should be about 6 inches square and its height at the eaves about 8 inches. The roof should be hinged at the top for removing the eggs or young. Such boxes may be built of rough boards at slight cost. By distributing a number of them about orchards, shade trees, and out-buildings, and catching the sparrows that occupy them, or by destroying eggs, the work of extermination may be carried on at a season when other methods are least effective.

Preliminary to the following destructive measures, sparrows should be baited until they are attached to the spot selected for their execution. Seeds, grain, or waste from the table, if supplied regularly, will soon establish a feeding place. If a general campaign is to be undertaken, enough such feeding places should be maintained to attract to them practically all the English sparrows in the neighborhood. This can easily be done in winter when food is scarce. After thus baiting the sparrows they may be trapped, shot, or poisoned.

Traps alone are inadequate to exterminate sparrows, but a reduction of numbers can be effected by using a shallow box not less than 4 feet square, open on one side and covered with woven wire on the other. One side of this trap rests on the ground, while the opposite side is supported by a stick 18 inches long. Near the upper end of this stick is attached a long cord, and between the top of it and the edge of the trap is placed a chip. By setting the trap over bait and pulling the cord from a sheltered point of observation when a flock of sparrows is beneath it, numbers of them may be caught. Instead of the box described above, by which the birds are taken alive, an old door or similar device may be employed as a deadfall. In either case the trap should be kept set and baited until the sparrows are not afraid

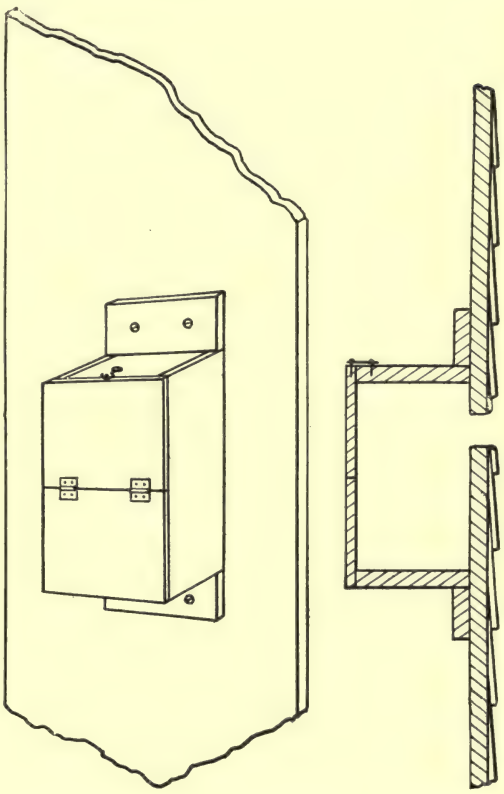
to go under it. The best time for trapping is just after a snowstorm, when the birds have been fasting. Then, if the ground be cleared and chaff and grain be put under the trap, the birds will crowd in and enable the trapper to secure nearly all of the local flock. If any escape they will spread the fear of traps, and before long very few of the birds can be induced to go into one.

Sparrows are accustomed to feed in close flocks, and when thus assembled a large number can be killed by a charge of No. 10 shot. The best way is to scatter grain over long, narrow areas and shoot the sparrows at these baiting places. Where sparrows infest poultry yards, the bait may be placed on a horizontal board, supported at such an elevation that the birds can be shot without danger to the poultry.

Since English sparrows are a pest and a reduction of their numbers is important on economic grounds, there would seem to be no reason why the birds, when trapped or shot, should not be utilized for food in this country, as they have been in the Old World for centuries. Their flesh is palatable and nutritious, and in city restaurants they are often served under the name of reed birds.

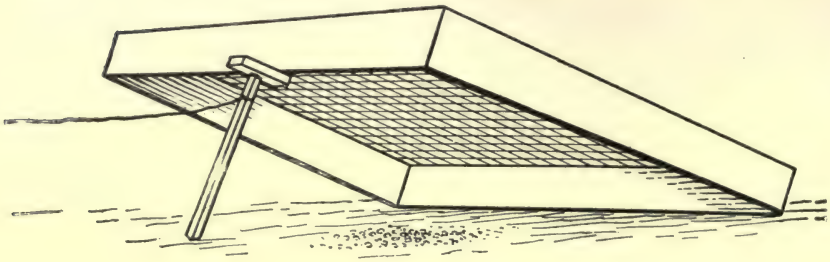
Where the use of poison is not prohibited by law, it may be effectively used to reduce the number of sparrows. Of the different poisons tested, the most satisfactory is strychnia sulphate. It is easily prepared and acts quickly. Wheat has proved to be a good bait, as well as an excellent vehicle for administering the poison. The grain should be regularly supplied at the baiting stations until the birds have become accustomed to resort to the place. A good time to put it out is early morning, as the birds are sure to be hungry for breakfast. The capacity of the sparrow's crop and stomach is about 30 kernels of wheat, varying according to size of the kernels.

In deciding the amount of poisoned wheat to put out at one time, it is well to estimate the number of sparrows frequenting a feeding place and to allow about 20 kernels for each sparrow.



PERSPECTIVE AND SECTIONAL DRAWINGS OF AN IMPROVISED NESTING-BOX FOR THE INTERIOR OF BUILDINGS

Although 2 kernels of wheat coated with the solution described below have been known to kill a sparrow, 6 or 7 kernels are required to insure fatal results. Only as much poison should be put out as is likely to be eaten in one day, as exposure to moisture reduces its virulence. Furthermore, sparrows that take less than a fatal quantity, or that become frightened by the death of comrades, will forsake a feeding place if poison is kept there constantly. It is better, therefore, to supply unpoisoned wheat after each poisoning until the birds have recovered confidence. An important advantage in having several feeding grounds is that they may be used in rotation, the sparrows forgetting their fear of one while the others in turn are receiving poison.



A SPARROW TRAP

A poison mixture that has proved very effective is prepared as follows: Put one-eighth ounce of strychnia sulphate into three-fourths of a gill of hot water and boil until dissolved. Moisten 1½ teaspoonfuls of starch with a few drops of cold water, add it to the poison solution, and heat till the starch thickens. Pour the hot poisoned starch solution over 1 quart of wheat and stir until every kernel is coated. Small-kerneled wheat sold as poultry food, if reasonably clean, is preferable to first-quality grain, being cheaper and more easily eaten by the sparrows. A 2-quart glass fruit jar is a good vessel to mix in, as it is easily shaken and allows the condition of the contents to be seen. If the coated wheat be spread thinly on a hard, flat surface, it will dry enough for use in a short time. It should be dried thoroughly if it is to be put into jars and kept for future use. Dishes employed in preparing poison may be safely cleansed by washing.

The poison should be well scattered, so that many birds may be able to partake at the same time, since after a few are affected their actions excite the suspicion of their comrades. Usually a few sparrows get only enough strychnine to paralyze them for a few hours, after which they recover. It is important, therefore, to visit the feeding places two or three hours after distributing poison to prevent such birds from escaping. It is well also to remove dead birds promptly to avoid exciting the suspicions of those that are unaffected. In northern latitudes the best time to put out poison is just after a snowstorm, when other food is covered. The feeding place should be cleared of snow and the poison laid early in the morning.

Sparrows should be baited in secluded places, safe from interruptions and where doves and poultry are not endangered. Roofs, back yards, and unused poultry runs are favorable situations. Proximity to low trees, grape arbors, and similar retreats has the advantage that sparrows go to such places between meals, and many dead birds will be found there well away from the bait. If undisturbed, poisoned birds will usually be found within a few feet of where the bait was spread, death occurring in from three to twenty minutes. Where doves or poultry are likely to be poisoned, the sparrows, after being baited, may be induced to feed in small covered pens made of coarsely meshed wire netting and having the sides raised about an inch and a half above the ground. There is practically no danger that cats or other animals will die from eating sparrows that have been poisoned. Any wheat coated by the above process, which is overlooked by the birds, will become harmless after a few rains.

Sparrows can be reduced locally to almost any desired extent by the methods outlined above, but it should not be forgotten that such reduction can be made permanent only by systematic and continued efforts.

MR ROOSEVELT'S "AFRICAN GAME TRAILS"*

IN these greatest of the world's great hunting grounds there are mountain peaks whose snows are dazzling under the equatorial sun; swamps where the slime oozes and bubbles and festers in the steaming heat; lakes like seas; skies that burn above deserts where the iron desolation is shrouded from view by the wavering mockery of the mirage; vast grassy plains where palms and thorn trees fringe the dwindling streams; mighty rivers rushing out of the heart of the continent through the sadness of endless marshes; forests of gorgeous beauty, where death broods in the dark and silent depths.

"There are regions as healthy as the northland, and other regions, radiant with bright-hued flowers, birds, and butterflies, odorous with sweet and heavy scents, but treacherous in their beauty and sinister to human life. On the land and in the water there are dread brutes that feed on the flesh of man, and among the lower things that crawl, and fly, and sting, and bite, he finds swarming foes far more evil and deadly than any beast or reptile—foes that kill his crops and his cattle; foes before which he himself perishes in his hundreds of thousands. . . .

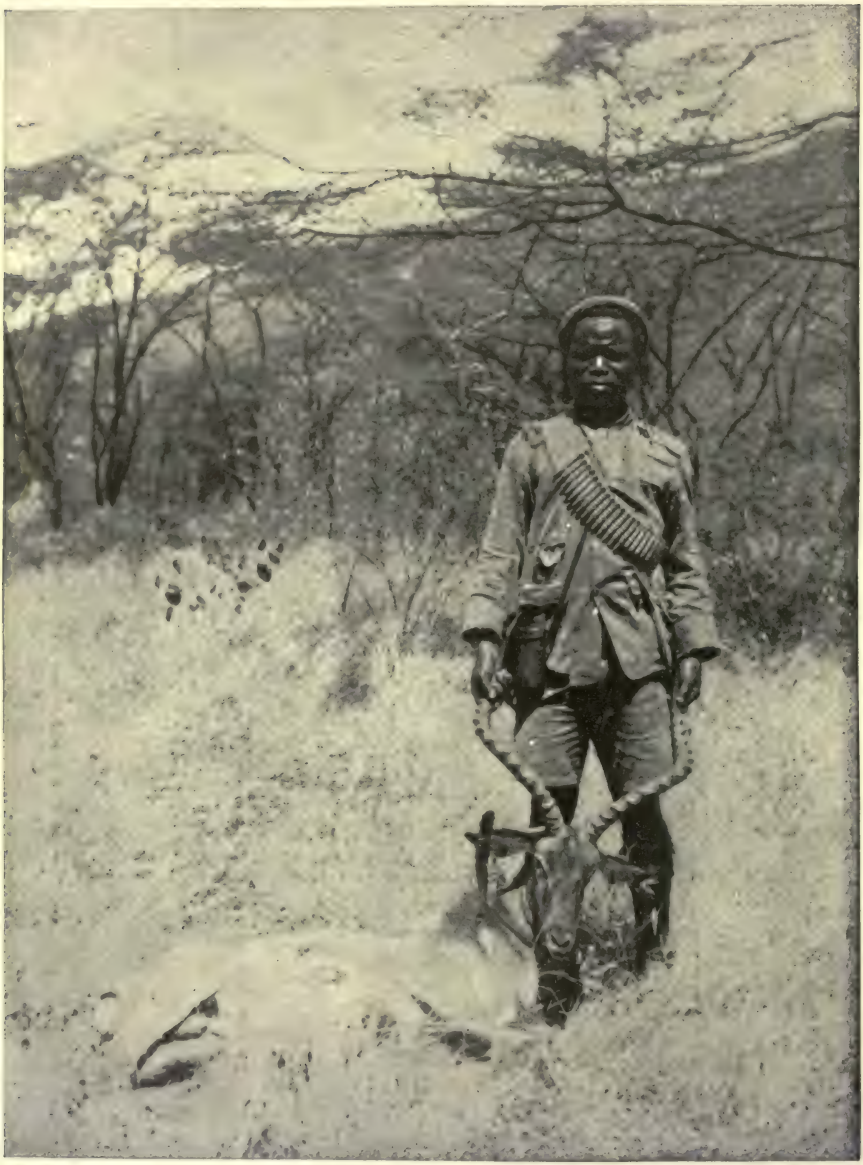
"The land teems with beasts of the chase, infinite in number and incredible in variety. It holds the fiercest beasts of ravin, and the fleetest and most timid of those beings that live in undying fear of talon and fang. It holds the largest and the smallest of hoofed animals. It holds the mightiest creatures that tread the earth or swim in its rivers; it also holds distant kinfolk of these same creatures, no bigger than woodchucks, which dwell in crannies of the rocks and in the treetops. There are antelope smaller than hares, and antelope larger than oxen. There are creatures which are the

From "African Game Trails," by Theodore Roosevelt. Copyright by Charles Scribner's Sons

THE MONITOR LIZARD ROBBING A CROCODILE'S NEST

From a photograph by J. Alden Loring

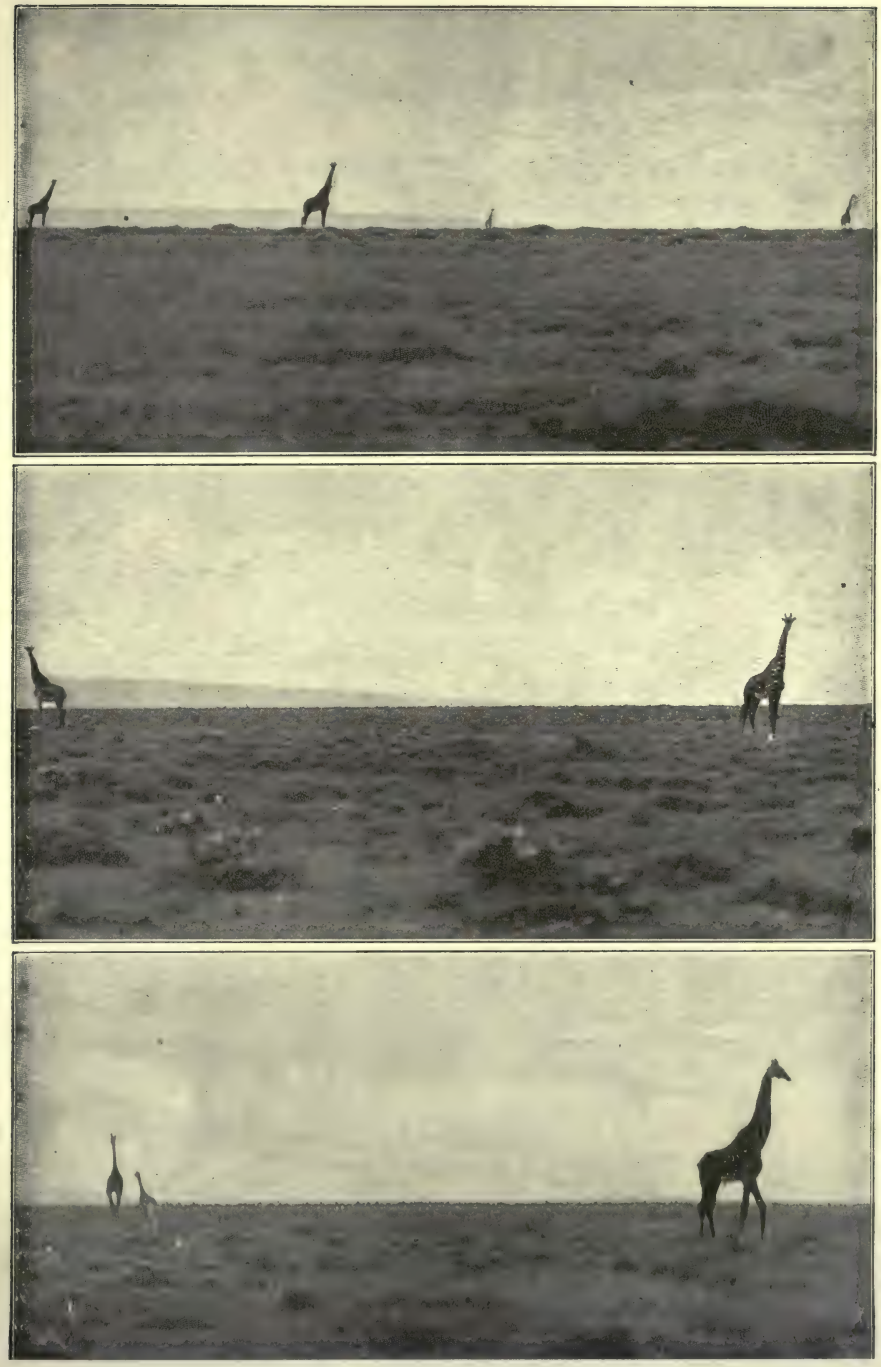
*African Game Trails. An account of the African wanderings of an American Hunter-Naturalist. By Theodore Roosevelt. With illustrations from photographs by Kermit Roosevelt and other members of the Expedition, and from drawings by Philip R. Goodwin. New York: Charles Scribner's Sons. 1910. $4.00 *net*.



From "African Game Trails," by Theodore Roosevelt. Copyright by Charles Scribner's Sons

AN IMPALLA BUCK KILLED BY KERMIT ROOSEVELT AT LAKE HANNINGTON, SHOWING THE BROKEN HORN OF ANOTHER RAM IMBEDDED IN ITS NECK

From a photograph by Kermit Roosevelt



From "African Game Trails," by Theodore Roosevelt. Copyright by Charles Scribner's Sons

GIRAFFE AT HOME

From photographs by Kermit Roosevelt

From "African Game Trails," by Theodore Roosevelt. Copyright by Charles Scribner's Sons

ONE OF THE MOST REMARKABLE PHOTOS OF WILD GAME EVER MADE: A HERD OF ELEPHANT IN AN OPEN FOREST OF HIGH TIMBER

From a photograph by Kermit Roosevelt, taken from a distance of about twenty-five yards; he was on the dead limb of a tree five or six feet from the ground

From "African Game Trails," by Theodore Roosevelt. Copyright by Charles Scribner's Sons

AS THE LION FELL HE GRIPPED A SPEAR-HEAD IN HIS JAWS WITH SUCH TREMENDOUS FORCE THAT HE BENT IT DOUBLE (SEE PAGE 960)

From a photograph by Kermit Roosevelt

embodiments of grace, and others whose huge ungainliness is like that of a shape in a nightmare."

The preceding paragraphs, quoted from Mr Roosevelt's foreword to the narrative of his African expedition, introduce the reader to the wonder world where he collected specimens for the National Museum for nearly one year. The sights which he saw are described so vividly and accurately that even the most quiet and unimaginative citizen thousands of miles from the scene of Africa's grandeur can easily picture the extraordinary contrasts which remain so fixed in Mr Roosevelt's mind, and is also stirred by the wondrous beauty and weird surroundings which Mr Roosevelt so keenly enjoyed.

The book is an unusual contribution to science, geography, literature, and adventure. Naturalists will prize the accurate descriptions of the huge beasts by a hunter-naturalist who for 30 years had been studying the big game of America in their native haunts, and who has contributed much to a better appreciation of the large animals of our continent. Mr Roosevelt's acquaintance with big game in America prepared him to observe the great bulky creatures of Africa with eyes quick to note and understand. He is the first naturalist of much experience with American big game to study all the large species of Africa, so that his comparisons and observations form a particularly valuable contribution to knowledge.

The geographer will perhaps be even more interested in the accounts of the people and of the country. In the first chapter, "Through the Pleistocene," he reads of a land where wild man and wild beast do not differ materially from what they were in Europe many thousands of

From "African Game Trails," by Theodore Roosevelt. Copyright by Charles Scribner's Sons

THE COW AND CALF SQUARE-NOSED RHINO UNDER THE TREE AFTER BEING DISTURBED BY THE CLICK OF THE CAMERA

From a photograph by Kermit Roosevelt, whose pictures of white rhino are the first photographs ever made of this rare animal alive

From "African Game Trails," by Theodore Roosevelt. Copyright by Charles Scribner's Sons

A WHITE RHINO AND CALF

The calf, which was old enough to shift for itself, refused to leave the body. From a photograph by Kermit Roosevelt

years ago, in the age when our ancestors in Europe went absolutely naked and lived in constant dread of furious beasts. Into this land European civilization is rushing with tremendous sweep and reaping big commercial profits. It is a strange sight as the train, drawn by an American Baldwin locomotive, rolls into the towns to see groups of naked savages with oddly shaved heads and filed teeth, armed with primitive bows and arrows, and women whose ideas of the requirements of dress are fully satisfied by masses of bronze or copper wire wound tightly around the arms and legs.

"One group of women, nearly nude, had their upper arms so tightly bound with masses of bronze and copper wire that their muscles were completely malformed. So tightly was the wire wrapped round the upper third of the upper arm that it was reduced to about one-half of its normal size, and the muscles could only play, and that in deformed fashion, below this unyielding metal bandage. Why the arms did not mortify it was hard to say, and their freedom of use was so hampered as to make it difficult to understand how men or women whose whole lives are passed in one or another form of manual labor could inflict upon themselves such crippling and pointless punishment."

Kermit Roosevelt's photographs of the big game are unusually fine. Those of the elephant herd, of which one is printed on page 956 of this Magazine, are better than any of wild elephants that have ever been taken, while those of the white, or square-nosed, rhino (see pages 958, 959) are, so far as we know, the first live pictures of this rare animal that have ever been made. To photograph the elephant requires especial courage and ability. The huge beast is exceedingly wary and suspicious and easily

aroused to anger. Their strength is prodigious. "They work vast havoc among the young or small growth of a forest, and the readiness with which they uproot, overturn, or break off medium-sized trees conveys a striking impression of their enormous strength. I have seen a tree a foot in diameter thus uprooted and overturned."

The elephant formerly wandered freely over the plains, but, learning some years ago that the open country was becoming dangerous, owing to the advent of the white man and his rifle, he took to the forests and can now be found only after days of fatiguing pursuit in the thickest woods. There is no danger, says Mr Roosevelt, that this magnificent animal will become extinct, because large elephant reserves have been established; and, furthermore, wise regulations have been adopted and are being enforced, such as prohibiting the sale of tusks below a certain size, the shooting of females except for museums, etc.

Not the least interesting portions of Mr Roosevelt's narrative are his descriptions of the small mammals, birds, and the ants, bees, and deadly flies and ticks.

The dreaded driver ants "are carnivorous; I have seen both red and black species. They kill every living thing in their path, and I have known them at night drive all the men in a camp out into the jungle to fight the mosquitoes unprotected until daylight. On another occasion, where a steamboat was moored close to a bank, an ant column entered the boat after nightfall and kept complete possession of it for 48 hours. Fires and boiling water offer the only effectual means of resistance. The bees are at times as formidable; when their nests are disturbed they will attack every one in sight, driving all the crew of a boat overboard or scattering a safari, and not infrequently killing men and beasts of burden that are unable to reach some place of safety."

Among the first specimens obtained were a cow and bull of the ugly wildebeest. "They were covered with ticks, especially wherever the skin was bare. Around the eyes the loathsome creatures swarmed so as to make complete rims like spectacles, and in the armpits and the groin they were massed so that they looked like barnacles on an old boat. It is astonishing that the game should mind them so little. The wildebeest evidently dreaded far more the biting flies which hung around them, and the maggots of the bot-flies in their nostrils must have been a sore torment. Nature is merciless, indeed."

Few of the many millions of Americans who in coming years will admire and profit from the splendid series of specimens of African big game obtained by Mr Roosevelt for our National Museum have any conception of the immense physical labor, the careful planning, and extensive preparations required to secure this complete collection. As an instance of the labor involved, we mention the hunt for the giant eland, the largest and handsomest and one of the least known of African antelopes, described in the last chapter of the book "Down the Nile." This giant antelope with its powerful horns easily breaks off branches two or three inches in diameter and seven or eight feet from the ground to get at the leaves and bean-pods of the tree which forms its favorite food.

This task involved an 8-days' trip from Gondokoro through a hard, dry, barren country and in temperatures of 112 degrees in the shade at noon. Kermit was the only white man to accompany Mr Roosevelt, as all the other white men of the party were down with dysentery or fever.

"It took me three days' work before I got my eland. Each day I left camp before sunrise, and on the first two I came back after dark, while it always happened that at noon we were on a trail and could not stop. . . . On the third day we found the spoor of a single bull by 8 o'clock. Hour after hour went by while the gun-bearers, even more eager than weary, puzzled out the trail. At half past 12 we knew we were close on the beast, and immediately afterward caught a glimpse of it. Taking advan-

tage of every patch of cover, I crawled toward it on all-fours, my rifle too hot for me to touch the barrel, while the blistering heat of the baked ground hurt my hands. At a little over a hundred yards I knelt and aimed at the noble beast. I could now plainly see his huge bulk and great, massive horns, as he stood under a tree." The first shot brought him down. "Meanwhile Kermit had killed two eland—a cow on the first day, and on the second a bull even better than, although not quite so old as, mine. Kermit could see game and follow tracks almost as well as his gun-bearers, and in a long chase could outrun them."

But to save the three big skins in that climate was even harder work than the many hours of hunting had been, but they did it, though it took till midnight to get the skins in proper condition for transportation.

The buffaloes, and particularly the very rare square-nosed or "white" rhino, demanded even greater exertions of the party. Of the square-nosed rhino (see pages 958, 959) only two specimens, and both very poor ones, had been previously secured for any museum, one being at Berlin and the other at London. Mr Roosevelt shot five splendid specimens in the Lado and Kermit four, and all nine animals were saved for the U. S. National Museum.

No one can read the volume without being impressed by the serious purpose of the leader and of every member of his staff. This was in no sense a hunting party for the collection of record heads and horns, but an expedition organized, equipped, and directed by some of the ablest naturalists in the world, all of whom were animated with the sole ambition to bring back some contribution to science.

While the leader and his son were toiling strenuously for the big-game specimens, Major Mearns, Dr Loring, and Mr Heller were collecting and trapping (they took hundreds of traps with them) long series of rats, mice, squirrels, monkeys, shrews, bats, lizards, reptiles, birds, fishes, and plants. Every man had his particular field of work and did it well, with the result that our National Museum will possess the finest and most valuable collection of African fauna in any museum.

Mr Roosevelt during the trip shot with the rifle 296 big game and Kermit 216—a grand total of 512. "Kermit and I kept about a dozen trophies for ourselves; otherwise we shot nothing that was not used either as a museum specimen or for meat—usually for both purposes. We were in hunting grounds practically as good as any that have ever existed; but we did not kill a tenth nor a hundredth part of what we might have killed had we been willing. The mere size of the bag indicates little as to a man's prowess as a hunter, and almost nothing as to the interest or value of his achievement."

To the writer of this review, "African Game Trails" appeals as the strongest and best work of literature Mr Roosevelt has yet written. The word pictures are extraordinarily vivid and realistic. He who seeks stories of adventure will be entranced by the many strange situations, and will rejoice in such descriptions as that of the hunt of a lion by the naked Nandi warriors armed only with shields and spears.

"One by one the spearmen came up, at a run, and gradually began to form a ring round him. Each, when he came near enough, crouched behind his shield, his spear in his right hand, his fierce, eager face peering over the shield rim. As man followed man, the lion rose to his feet. His mane bristled, his tail lashed, he held his head low, the upper lip now drooping over the jaws, now drawn up so as to show the gleam of the long fangs. He faced first one way and then another, and never ceased to utter his murderous grunting roars. It was a wild sight—the ring of spearmen, intent, silent, bent on blood, and in the center the great man-killing beast, his thunderous wrath growing ever more dangerous.

"At last the tense ring was complete, and the spearmen rose and closed in. The lion looked quickly from side to

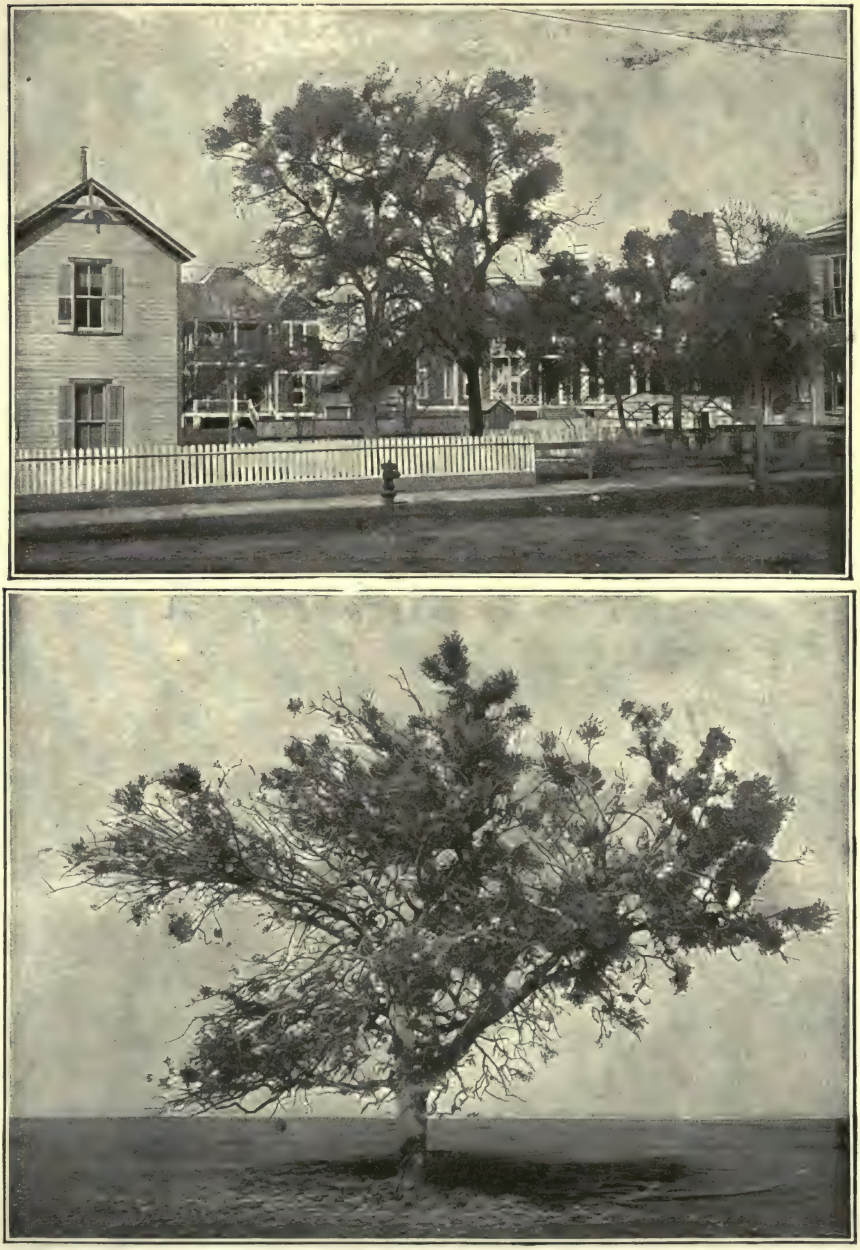
side, saw where the line was thinnest, and charged at his topmost speed. The crowded moment began. With shields held steady and quivering spears poised, the men in front braced themselves for the rush and the shock, and from either hand the warriors sprang forward to take their foe in flank. Bounding ahead of his fellows, the leader reached throwing distance; the long spear flickered and plunged; as the lion felt the wound he half turned, and then flung himself on the man in front. The warrior threw his spear; it drove deep into the life, for entering at one shoulder it came out of the opposite flank, near the thigh—a yard of steel through the great body. Rearing, the lion struck the man, bearing down the shield, his back arched, and for a moment he slaked his fury with fang and talon. But on the instant I saw another spear driven clear through his body from side to side; and, as the lion turned again, the bright spear blades darting toward him were flashes of white flame. The end had come. He seized another man, who stabbed him and wrenched loose. As he fell he gripped a spear-head in his jaws with such tremendous force that he bent it double. Then the warriors were round and over him, stabbing and shouting, wild with furious exultation.

"From the moment when he charged until his death I doubt whether ten seconds had elapsed, perhaps less; but what a ten seconds! The first half dozen spears had done the work. Three of the spear-blades had gone clear through the body, the points projecting several inches, and these and one or two others, including the one he had seized in his jaws, had been twisted out of shape in the terrible death struggle."*

*All the quotations from "African Game Trails" are copyrighted by Charles Scribner's Sons.

A DEFORMED BRANCH OF A HACKBERRY TREE WHICH HAS BEEN INFECTED BY MISTLETOE FOR TEN TO TWELVE YEARS, NEAR BELTON, TEXAS

The dwarfing of the branch beyond the place of infection is shown. The original mistletoe plant has been destroyed, leaving a decayed spot. The young shoots of mistletoe seen are from adventitious buds.



Photos from William L. Bray, U. S. Department of Agriculture.

A CEDAR ELM TREE ON A VACANT LOT IN AUSTIN, TEX., SHOWING ITS WINTER CONDITION

All the foliage is mistletoe (see page 965)

AN ISOLATED HACKBERRY TREE NEAR BELTON, TEX., WITH INNUMERABLE BUNCHES OF MISTLETOE

This tree is in its winter condition, being absolutely without leaves of its own

MUD-CRACKS IN THE VALLEY OF THE LOWER COLORADO (SEE PAGE 967)

The revolver on one of the central blocks is a .38 Smith & Wesson Military, just 12 inches in total length. This gives an idea of the width of the cracks. Photo by J. Griffin

THE MUD-CRACKS UTILIZED: BEETS IN THE FOREGROUND, PEAS AT LEFT, WHEAT AT RIGHT, THE LATTER BEING THE CORNER OF A 10-ACRE TRACT (SEE PAGE 967)

At flood-time the previous June water covered this area to a depth of 8 feet, as shown by the mud-stain on willow trunks in the vicinity. Photo taken April 17, 1910, by J. Griffin.

THE MISTLETOE

PEOPLE living in northern cities who purchase small strings or bunches of mistletoe at a good price for Christmas decoration rarely are aware that it is one of the most destructive tree parasites known. There are localities in the South, particularly in Texas, where mistletoe is so abundant upon trees and so harmful as to make the control of the plant and its extermination a serious practical question. It is spread principally by birds—mocking-birds, robins, wax-wings, and cedar-birds—who carry the mistletoe berry from tree to tree. The sinker of the seedling pierces the tenderest portions of the tree, young branches or buds, and sucks away the tree's vitality by draining the water and nourishment of the tree (see pages 962, 963).

OUR COLORED PICTURES

IN this number of the Magazine, for the first time, the National Geographic Society publishes a large series of illustrations in color. These pictures are all from photographs taken by Mr William W. Chapin, a well-known citizen of Rochester, New York, and an amateur photographer of much skill. The photographs were colored by hand, under Mr Chapin's direction, by a Japanese artist. By the use of colors, the atmosphere and reality of foreign scenes in many instances can be more accurately and graphically portrayed than in the usual black-and-white illustration. This is particularly true of the Orient, where the use of bright, striking pigments—golden yellows, rich reds and blues and greens—are so prevalent in dress and street deco-

From "Hunting with the Eskimos," by Harry Whitney. Copyright by Century Company

STRIPPING BLUBBER FROM A WHALE

"In these modern factories every part of the whale is utilized. The oil and whalebone of commerce are very valuable, and the manufacture of the carcass into guano after the oil has been extracted is an industry in itself. Until recently the oil-freed carcass was considered useless refuse. It was towed 50 miles out to sea and abandoned. The law required this, that the fishing grounds might not be polluted. But a voyage of 50 miles to sea and back again is costly, and through experiment it was learned, not only that this expense might be saved, but that it was possible to manufacture the refuse into a valuable commodity. So every part of the whale is turned to account except the smell. Human ingenuity cannot control that."—HARRY WHITNEY.

From "Hunting with the Eskimos," by Harry Whitney. Copyright by Century Company

MR HARRY WHITNEY IN A WHALE'S MOUTH

ration and in the architecture of the buildings.

The process by which the 39 pictures were engraved and reproduced for this Magazine cost the Society more than several ordinary issues of the publication, but it is believed that the beauty of the illustrations and the vivid manner in which the striking contrasts of eastern life are actually represented will more than compensate for the expense. The expenditure was made possible by the increasing revenue of the Society from the general sale of the Magazine and from advertising receipts. The Society will be glad to hear from the members what they think of the series, which incidentally is the largest collection of photographs in color ever published in a single issue of any magazine.

THE MAN WITHOUT THE HOE

PROBABLY nowhere in the United States is a more unique method of farming practiced than the one carried on by the few dwellers along the banks of the lower Colorado River, on the Cali-

A BATETELA DRUMMER OF THE BELGIAN CONGO SENDING A MESSAGE BY A WOODEN GONG

The natives of this part of Africa are celebrated for their proficiency in transmitting elaborate messages long distances by means of these resonant instruments. The women of these people wear enormous neck-rings of brass which frequently exceed 30 pounds in weight. Photo from E. Torday, in the Geographical Journal of London.

A BEAK-FACED WOMAN IN THE MUSGUN COUNTRY OF FRENCH NIGERIA, NEAR LAKE TCHAD

These people are magnificent specimens of humanity, but their women are exceedingly ugly. The upper and lower lips of their wives are pierced and have large discs of tin looking-glass and Maria Theresa dollars inserted in them. Photo from Dr Karl Kumm, in the Geographical Journal of London.

fornia side, some 45 miles above Yuma. The narrow flood-plain on either side of the Colorado at this point is lower than the banks immediately paralleling the river itself. Ordinarily the river runs between its self-made dikes of silt; but in June, when the melting snows of the mountains at its source enormously swell its volume, it overflows its banks and inundates the low ground on either side. These lateral bottom lands are covered with a dense growth of willow, arrow-weed, etc., and it is in the original clearing of them that the farmer meets with his hardest task. For, once cleared and fenced against the cattle that range the river bottom, his procedure is simple in the extreme.

In the arable valleys the flood-waters cover the land little more than a month, being drained by natural systems of sloughs soon after the high water recedes. There is thus yearly left after the subsidence of the waters a new deposit of rich alluvial mud. In the fierce heat of the desert sun and with a relative atmospheric humidity of as low as five per cent, the rate of evaporation is extraordinary and the surface of the mud dries quickly. As it dries it cracks, marking the whole surface into large blocks of fairly rectangular form, the cracks between them being from one to five inches in width and about twice as deep (see pages 964, 965).

The ground thus prepares itself for the seeding, which takes place in late autumn. The farmer merely sows his seed broadcast over this surface, then brushes over it with rude brooms made of arrow-weed, so that all the seed finds lodgment in the open cracks. Abundant moisture remains beneath the sheltering cakes of dried mud, and grain and all sorts of vegetables thrive splendidly. No cultivation of any sort is given, and all that remains for the farmer to do is to harvest his crop, in April or May, before the next season's flood. Surely Nature is nowhere kinder to the farmer than here, where his fields are yearly irrigated, fertilized, and plowed for him by her forces.

AMONG THE CANNIBALS OF BELGIAN KONGO

A RECENT number of the Geographical Journal of London contains an account by E. Torday of two years passed in the Kasai country of the Belgian Kongo. While the region explored is no larger than New York and Pennsylvania combined, it is so cut up by rivers and impenetrable forests that the tribes inhabiting the country vary greatly in their customs and language. Mr Torday found cannibals living undisturbed, and only a few miles distant geographically from these barbarous savages were endless plantations of millet and grain, tended by the most progressive negroes of Africa. The following notes are from his paper:

Each chief in the Bushongo country has a small group of pygmies under his suzerainty. These people hunt for him, and he provides them with vegetable food in exchange for their game. Now one group, abandoning the nomadic life, has established itself in a small village and has taken to agriculture. Only two generations have passed since they left the forest, and they have already lost their pygmy appearance. Though not as big as the Bushongo, they have attained a stature far superior to that of the average pygmy. As intermarriage between Bushongo and these "half ghosts" (which they are considered to be) is out of the question, it must be admitted that sunshine, air, and regular life have been the main factors in this change. The Bushongo, who believe that pygmies are semi-ghosts born from crevices of old trees, told us that these Batwa, since the time they adopted the normal life of human creatures, even reproduce like ordinary men, and showed us, as a great curiosity, some normally born young babies.

I cannot even make an attempt to give a description of the art of this people. Those who take interest in it will find in the British Museum many hundreds of objects collected by me, and will be obliged to admit that a really pure African art has been evolved by them—an art which must be ranked high, even

A BATETELA OF THE BELGIAN KONGO

Note the peculiar method of shaving the head. The members of this tribe were formerly cannibals, but have now become splendid agriculturalists and stock-breeders. They are very industrious and progressive. See page 971.

A BANKUTU CANNIBAL OF THE BELGIAN KONGO

The scars on the man's body show the tribe to which he belongs. These savages use poisoned arrows and spring guns. See page 971.

when judged by the standard of civilized peoples.

Cicatrization is practiced by all the tribes; in some by the men only, in others by the women only. The tribal mark of one tribe consists in a series of concentric circles on each temple. The incisor teeth are all filed to a point, and from this circumstance the Basongo Meno have received the tribal name which they now bear, meaning "People with filed teeth."

The cannibal Bankutus remove the upper incisors. Their dress consists of a pleated skirt, which does not quite meet on the right thigh; but the women in the south wear a hide girdle with a deep fringe of palm-fiber string. Among this tribe the slaves are compelled to wear a special dress, which is, in fact, the ordinary costume of the Akela, to which tribe most of them belong.

The Bankutu are great cannibals, as far as the male members of the tribe are concerned, and the victims are always slaves. In fact, all slaves are ultimately eaten, since it is believed that if a slave were buried his ghost would kill his master.

Their chief weapon is the bow, and poison is used on the arrows; shields are now obsolete. Property descends in the male line, but there are indications that at one time relationship was considered stronger on the female side. One of the most interesting points among this tribe is their use of a conventional throwing-knife as currency. The Basongo Meno also use this form of currency, obtaining it from the Bankutu, who are the manufacturers. The Bankutu are almost the only tribe of this region who have been successful up to the present in resisting the advance of the white man. This fact is due to their skill in forest warfare.

It is difficult to give a description of Bankutu warfare without falling into the style of the literature which so successfully educates the future Bill Sykes. It will suffice to say that the way leading to their village is defended by poisoned spikes hidden by leaves; that they use bows and arrows set like traps in the form of primitive spring guns, and are quite ready, if a white man is expected, to bait such traps with a live baby, being sure that the European will be unable to resist the temptation to pick up an apparently abandoned child. The poison they use is absolutely deadly. We were most inhospitably received by them, but no violence was attempted toward us, although we had no escort. When we reached Kole we were criticised for crossing such a country without an armed force. Our reason for taking this risk was that, had we had troops with us, we should have never seen the natives at all, and most likely should have been ambushed.

Only a few score miles from the cannibal country we found peace and security reigning everywhere. The endless plantations, clean villages, and well-kept houses made an impression of general prosperity. Of course, equal credit for this must be given to the character of the population; the Batetela is an excellent agriculturist and stock-breeder and very industrious. He is the least conservative of all negroes I know; any innovation will tempt him. Rice, Madagascar potatoes, and fruit trees imported by the white man are found in every village. We were received in all of these with the greatest hospitality, and in one village the chief presented us with 500 huge rations for our 50 carriers.

The people are scantily clothed, but this is, of course, of great advantage in their hunting expeditions. The havoc of sleeping sickness is greatly limited by the native custom of isolating cases of this disease in the forest. Several of the villages are assuming the proportions of towns. The native pattern of hut is discarded, and plaster-thatched houses, laid out in neat and regular streets, have taken their place. The neatness and cleanliness of these villages are most remarkable.

An interesting feature of Batetela psychology lies in the fact that suicide appears not to be uncommon and is regarded as an act of courage. Descent is reckoned in the male line, and children are considered as more closely akin to the father's family.

NATIONAL GEOGRAPHIC SOCIETY

THE program of addresses before the National Geographic Society for 1910-1911 is as follows:

November 18.—"Wild Man and Wild Beast in Africa." By Colonel Theodore Roosevelt.

November 25.—"A Glimpse of Portugal." By Miss Laura Bell. Miss Bell was in Portugal for several months during the past summer, and has had an exceptional opportunity to understand the people and conditions of this picturesque country. Illustrated.

December 2.—"Four Journeys of a Naturalist in the Islands of the South Pacific." By Henry E. Crampton, Ph. D., of the American Museum of Natural History. Dr Crampton will tell of his travels in the Society, Cook, Tonga, Samoan and Hawaiian Islands, and in New Zealand. The natives, their every-day lives and ceremonies, the active volcanoes of Samoa and Hawaii, and the free life of the Pacific will be described. Illustrated.

December 9.—"My Friends, the Indians." By Mr Frederic Monsen. Illustrated with colorgraphs and motion pictures. Mr Monsen for years has been studying the Indians of Arizona and New Mexico, and his series of pictures of Indian life and manners are as beautiful as they are instructive.

December 16.—"The Glories, Sorrows, and Hopes of Ireland." By Mr Seumas MacManus, author of "A Lad of the O'Friel's," "Through the Turf Smoke," "Donegal Fairy Stories," "Ballads of a Country Boy," etc. Illustrated.

December 23.—Christmas recess.

December 30.—"From Babel to Esperanto—the Complication of Mother Tongues and the Simplicity of Esperanto." By Prof. A. Christen. Professor Christen is the leading authority on Esperanto. The growth of internationalism and the need of a world tongue lend interest to this topic. "Esperanto is spreading in almost every European nation, and is more easily learned and pronounced than any other foreign language. It is taught in all the higher military and naval schools of France, and at Lille has been taught in the public schools for the past three years."

January 6.—"Arab Life in Tunisia." By Frank Edward Johnson. Mr Johnson has probably seen more of the Barbary States than any other American. His lecture includes Tunis ("the White City"), the remains of Carthage and other buried Roman cities, Kairowan with its 85 mosques and 90 praying places, and descriptions of the Arabs in the oases and in the desert. Illustrated

January 13.—"The Methods, the Achievements, and the Character of the Japanese." By Mr George Kennan. Illustrated.

January 20.—"Making Pictures. The Wonderful Development of the Art of Photography and Its Value to Education and Commerce." By Hon. O. P. Austin, Chief of the United States Bureau of Statistics and Secretary of the National Geographic Society. Illustrated with motion pictures.

January 27.—"The Panama Canal." By Col. George W. Goethals, Chief Engineer Panama Canal. Illustrated.

February 3.—"Our Plant Immigrants." By Mr David Fairchild, in charge of Agricultural Explorations of the Department of Agriculture. The hunt for valuable new plants and fruits takes the agricultural explorers to many unknown corners of the world, and is a fascinating story of achievement. Illustrated.

February 10.—"The Balkan States." By Mr E. M. Newman. With motion pictures.

February 17.—"The Heart of Turkestan." By Mr William E. Curtis. Illustrated.

February 24.—"The Italy of Today." By Maj. Gen. A. W. Greely, U. S. Army. General Greely has just returned to the United States after spending a year in Italy, where he obtained much information as to the remarkable progress of modern Italy. Illustrated.

March 3.—"The Birds of Mexico." By Mr Frank M. Chapman, of the American Museum of Natural History. With motion pictures of roseate spoon-bills, man-o'-war birds, and white ibises.

March 10.—"From the Amazon to the Orinoco. The Five Guianas." By Mrs Harriet Chalmers Adams. With motion pictures.

March 17.—"Travels and Experiences in Mexico." By Mr John Birkinbine, President of the American Institute of Mining Engineers. Illustrated.

March 24.—"The Shrines of Greece: Olympia, Delphi, Eleusis, Athens, Mycenæ, Tiryns, Epidauros, and the Island of Crete." By Miss Marion Cock. Illustrated.

March 31.—"The Romance and Grandeur of Spain." By Dr Charles Upson Clark, of Yale University. Illustrated.

April 7.—It is hoped that former Vice-President Charles W. Fairbanks will be able to address the Society on this date on some subject connected with his recent journey around the world.

April 14.—"The Fiords and Fisheries of Norway." By Dr Hugh M. Smith, Deputy Commissioner of the Bureau of Fisheries. With motion pictures.

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THE NATIONAL GEOGRAPHIC MAGAZINE

RACE PREJUDICE IN THE FAR EAST

By Melville E. Stone

General Manager of the Associated Press

ALTHOUGH whole libraries have been written concerning Asia and the Asians, there is a widespread belief that, because of the differences in our mentalities, it is not possible for us ever to understand them, or they us. Kipling says that "East is East, and West is West, and never the twain shall meet." The "oldest inhabitant" in India or China or Japan is sure to tell you that the Oriental mind is unfathomable. I have not the temerity to challenge these opinions. And yet I venture to suggest that there is an older authority holding a different view, and that I still have some respect for Cicero's idea that there is a "common bond" uniting all of the children of men.

And whatever our ignorance of, or indifference for, the Orientals in the past, it is well to note that conditions, both for us and for them, have entirely changed within the last decade. There is a new United States and a new Asia. The Spanish War created the one; the Russo-Japanese War the other. When we acquired the Philippine Islands we assumed the government of eight millions of Orientals and touched elbow with all Asia. When Japan defeated Russia, the Oriental learned his power. For untold centuries he had respected power. His native sovereign was an autocrat, who enslaved him, beat him, killed him, if need be. Then came the European, with powder and guns and warships; and thereafter the white man behind the gun represented power. A handful of British with cannon could enforce obedience from hundreds of millions of people. Suddenly the little Empire of Japan, one of the least among the Asiatic powers, challenged, fought, and defeated the great European Colossus, Russia.

The Asian discovered then that it was not the white man, but the gun that did the business; he learned that a yellow man behind the gun was quite as effective as a white man, and he found that the Christian soldier alone was afraid of death. Then followed in travail the birth of the new Asia. There were actual revolutions in Turkey and Persia, a startling recrudescence of unrest in India and Ceylon, and, at this moment, China is in a state of revolutionary ferment.

What is to be the outcome? What does all this mean for the future of the world? Let us view the problem from the political, the commercial, and the moral aspects. How long will the 6,000 soldiers we have in the Philippines be able to keep our flag afloat among 8,000,-

Thousands of pilgrims come every year from all parts of China to visit the shrines and temples of the sacred mountain of Hunan, Nan Yoh Shan, one of the five sacred peaks of China. Early in October more than 10,000 pilgrims arrive daily. Some of the pilgrims travel from their homes on foot, coming great distances. They kneel and bow their heads down to the little stools which they carry in their hands every five, seven, or ten steps, according to the vow they have made. At one end of the stools are many sticks of incense, the burning of which is part of their worship. In a large majority of the cases the vows have been made on behalf of a sick mother, and the journeys are taken as an expression of thanksgiving in case of recovery, or as a prayer for mercies in the other world in case of a fatal issue of the illness. The leader of the above group, who stands at the extreme left, has made annual pilgrimages for 20 years. Photo from F. A. Keller, by courtesy of "China's Millions," of Toronto.

000 of natives? How long will the 75,000 English soldiers in India be able to maintain British sovereignty over 300,000,000 of Asians? Believe me, these are not idle questions. They are up to us for an answer, whether we will or no, and upon our ability to make answer will depend the future of what we are pleased to call our Western civilization. I would not be an alarmist, and yet I would have you feel that Macauley's suggestion of the New Zealander on a broken arch of London Bridge, sketching the ruins of St. Paul, has come to be more than an extravagant figure of speech.

And I am convinced that there is real danger awaiting us unless we mend our ways. It is not the Asian who needs educating; it is the European. I am not worrying half so much about the heathen in his blindness as I am about the Christian in his blindness.

Asia is awake and preparing for the coming struggle, and we are doing very much to force the issue and to prepare her for the contest. For a century we have been sending at enormous cost our missionaries to all parts of the hemisphere to civilize. There may be doubt as to the amount of proselyting we have been able to accomplish: there can be no possible doubt of the work we have done to strengthen the Asian people politically and commercially.

A statesman of Japan said recently, in a conversation I had with him: "Your missionaries undoubtedly have done good for the morals of our people, but they have done far more for our health and strength as a nation. They come to us with doctors, and nurses, and hospitals, and schools. Before Perry's arrival 2,000,000 infants were born every year in Japan, and for lack of proper sanitary measures they died. Now, with the hospitals and sanitary and hygienic methods introduced by the missionaries, the 2,000,000 children are born, but they do not die." This is true of every other Oriental country. Meanwhile, in the countries of Europe the increase of population is slow, and, in some countries, as in France, it is hardly increasing at all. In America race suicide is becoming alarmingly prevalent.

In the recent war between Russia and Japan, Dr. Louis Seaman, who visited their field hospitals and talked freely with their army surgeons, found that the Japanese had outstripped us in almost every department of military surgery. The foreign colonies of Tokio and other Japanese cities employ native physicians in preference to Europeans.

Asia is coming into her own again. It was Asia through Arabia which gave Europe the literature, the arts, and the sciences, which we have developed and of which we now boast. Gunpowder was probably invented in China; it was certainly introduced into Europe from Arabia. The finely-tempered steel of Damascus went over from Arabia at the time of the Moorish invasion of Spain, and its manufacture was continued at Toledo. The coppersmiths of Bagdad supplied the world's market with their wonderful productions centuries before there were any industries in Europe. Weaving of silk and cotton had its birth as an industry in Arabia, and the weaving of wool was learned by the Crusaders in the same wonderful country. Astronomy, mathematics, the mariner's compass—all came to us from the Arabs.

One cannot have forgotten that the Psalms, the Gospels, and the Koran are all of Arabian origin. The inhabitants of central Arabia have today the oldest liberal government—practically a republic—on earth. And, if you go farther afield, to India, and China, and Japan, you shall find a civilization older than history and marvelous in its character. One cannot read that great library of Eastern Sacred Writings, edited by Dr. Max Müller, without being tremendously impressed.

It will not do for us to assume that ours is the only civilization. What are the basic virtues, the sum of which we call our Christian civilization? I hope we are all agreed that they are not primarily beliefs in certain theological dogmas, or certain forms of church polity,

SOME PUPILS OF THE METHODIST EPISCOPAL DAY SCHOOL, BANGALORE, SOUTH INDIA: THE BOYS' SCHOOL HAS 80, THE GIRLS' SCHOOL 50 PUPILS

or in the shape or length of priestly vestments, but in the attributes of correct Christian living. Is frugality a virtue? Your Asian far exceeds us in frugality. Is industry a merit? No people on earth work as long, as persistently, and as conscientiously as they. Is integrity esteemed? It is the unchallenged judgment of every European writer that the word of an Asian was good until they were corrupted by the inroads of Westerners. Is politeness, which is but another name for the golden rule, to be commended? Nowhere will you find such scrupulous politeness as is daily and hourly observed east of Suez.

Is observance of law desirable? The peaceable and orderly lives which the great mass of the people of Asia have led for centuries attest their habits of obedience. There are cities in India, Japan, and China with crowded populations running from a hundred thousand into the millions where there is scarcely the semblance of police control, and where crime is hardly known. They are a calm, thoughtful people, to whom what Mr Arthur Benson has so well called "the gospel of push," and what our own vigorous Roosevelt calls a "strenuous life," is unknown. But I am not at all sure that this is an unmixed evil, for there are no "brain-storms" there, and neurasthenia is provided for nowhere. In the light of the fact that the number of inmates in the insane hospitals of our country doubled in six years, according to the latest available statistics, I cannot but feel that we need less strenuosity rather than more. Compared with Western civilization, theirs will not suffer perhaps as much as you would imagine; and perhaps you will agree that the chief characteristics of our civilization are push and extravagance, and that in this respect they have the better of us.

All this brings me to my topic. And I must say that, paraphrasing Mr Lincoln's words at Gettysburg, in large measure it is not for us to educate, but to be educated. We shall never meet the problems growing out of our relation with the Far East unless we absolutely and once for all put away race prejudice. I believe the European snob in Asia is distinctly the enemy of the civilized West. And his coadjutor in this country is a fitting criminal yoke-fellow. Let me give you some illustrations of what I mean—cases which came under my personal observation. From Bombay to Yokohama there is not a social club at any port or treaty point where a native, whatever his culture or refinement, will be admitted.

At the Bengal Club at Calcutta last year a member in perfectly good standing innocently invited a Eurasian gentleman—that is, one who is half native and half European—to dine with him. It became known that the invitation had been extended, and a storm of opposition broke among the members. The matter was finally adjusted by setting aside the ladies' department of the club, and there the offending member and his unfortunate guest dined alone. The next day the member was called before the board of governors and notified that another like breach of the rules would result in his expulsion.

The beating of native servants and workmen in India is a daily and hourly occurrence. It formerly was so at Hongkong and Shanghai, but Mr Sprague, the representative of the Standard Oil Company at Shanghai, told me that since the Russo-Japanese war the natives would not stand it, and that all beating of them by Europeans in that city had ceased.

While in Calcutta I attended a ball at Government House, and noted that while one or two native princesses were on the floor dancing with white men, there were twenty or more native gentlemen standing about as "wall flowers." I called the attention of Lady Minto to the fact, and she explained that no white woman would think of dancing with a native; it would certainly result in ostracism.

The son of a maharaja goes to England, is educated at Oxford or Cambridge, is lionized in the West End of London—mayhap he is honored with an

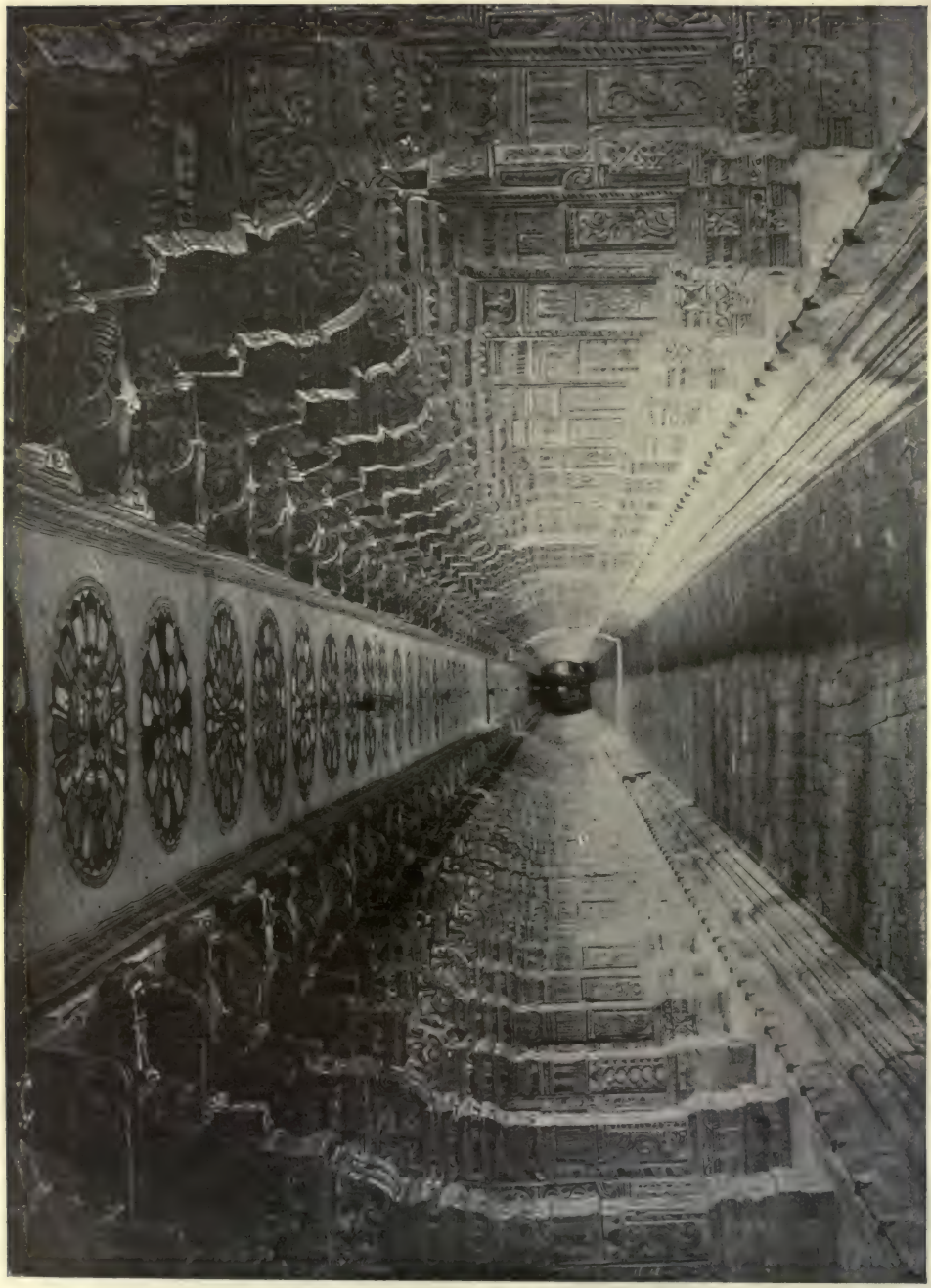


Photo by courtesy of New York Times

THE INTERIOR CLOISTER OF AN ANCIENT HINDU TEMPLE OF INDIA

invitation to Windsor. When he goes back home he may enter no white man's club; if he be fortunate enough to be invited to a white man's function, no white woman will dance or associate with him, and if by any luck he should marry a European, he, his wife, and his children become outcasts.

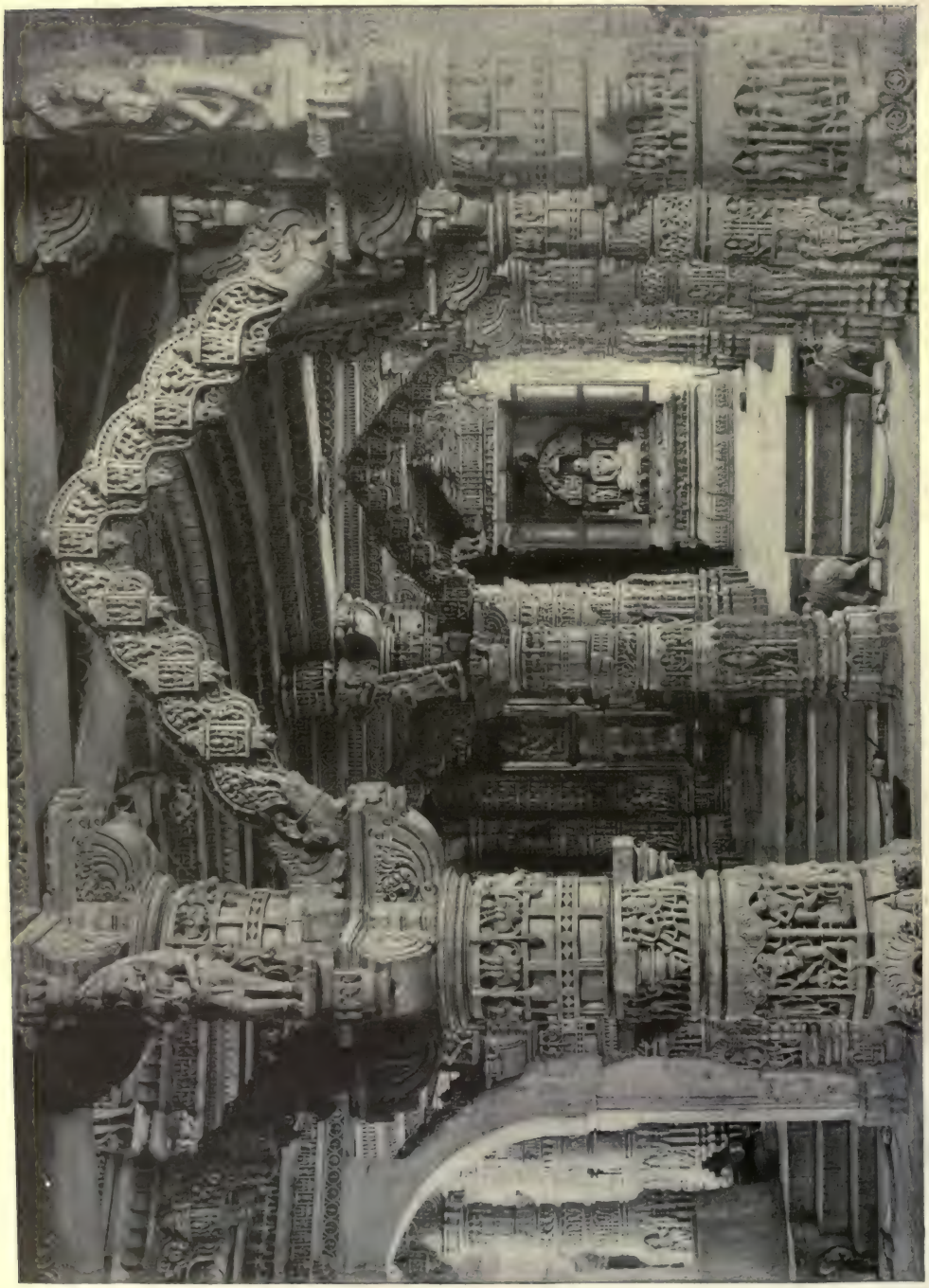
Although native troops, like the Sikhs, have shown undying loyalty to the British flag, and on frequent occasions have exhibited courage in the highest degree, no one of them ever has or ever can achieve the Victoria Cross.

I have no thought, in saying this, of criticising British rule in India. I do not question that it has been of enormous benefit. Neither do I doubt that under the administration of Lord Morley there is the most sincere desire to do all for India that the cause of humanity or Christianity may dictate. And I am also quite ready to say that the problem is a difficult one; that "the white man's burden" is one not easy to bear. I know that attempts to do justice are often misunderstood by the natives, are construed as evidence of fear. I know that the Bengalis, who are responsible for most of the unrest in India, are a silly lot, whose lives and property would not be worth a groat were British protection withdrawn. I know that the beneficent British supremacy has been made possible only by the religious divisions among the natives. But this is all the more reason why the greatest care should be exercised not alone in India, but throughout Asia, why the line of cleavage should not be permitted to pass from a religious to a racial one, and the danger that it may do so grows with every hour.

On the one hand, there is a very perceptible loosening of the bonds of religious caste; not infrequently today high-class Brahmins not only shake hands with Moslems and Christians, but even sit at table and eat meat with them. On the other hand, there was startling evidence during the recent war of the secret racial tie that binds all Asia. We are accustomed to think and speak of India as a British possession, forgetting that after all only five-eighths of its area is British, while there are over 600 native princes and chiefs, each governing a state, which is more or less independent. Some of these princes are enormously wealthy. So far as they have any religious bent, they are Hindu, or Mahratta, and in this respect not at all at one with the Japanese, who are either Shinto or Buddhist. Yet while the war was on, it was not uncommon for a rich Maharaja to call at Government House and ask if it would be regarded as an unfriendly act for him to buy Japanese bonds. Of course, the viceroy was forced to say it would not, since Britain and Japan were in treaty alliance. Of course, these investments were made through London banks, and the extent of the transactions will never be known. We do know, however, that there was a mysterious absorption of Japanese securities, which never could be accounted for by either the London financiers or our own.

What I feel is that the danger of Asiatic ethnic solidarity is immensely accentuated by the attitude of certain of the British themselves. It goes without saying that the younger son of a British nobleman, who does not succeed to his father's estate and does not go into trade, but who finds the only outlet for his activities in the army or navy, the church, or in the Indian civil service, becomes far more of a snob, and therefore far more of a danger when dealing with natives in Asia than he would be permitted to be at home in England. And the harm that one such person can do it may take an army to undo.

I have spoken thus freely respecting the conditions in India because I feel at liberty to do so, since my mother was born under the British flag, and I have a very large number of relatives in the British army, navy, and church. But I should be wholly lacking in fairness if I did not ask your attention to similar cases of race prejudice in which we are



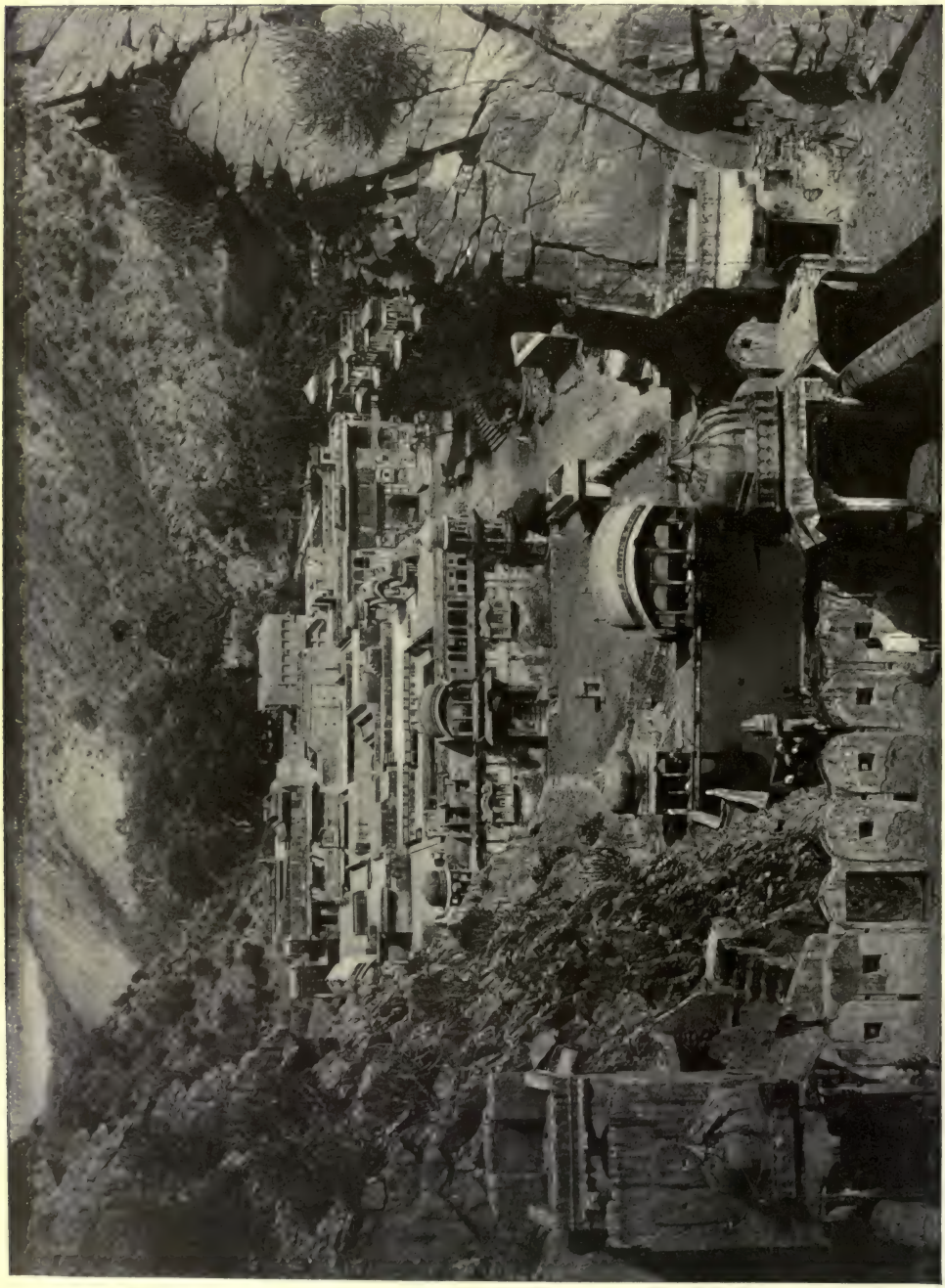
INTERIOR OF THE JAIN TEMPLE AT DILAWAR

Photo by courtesy of New York Times

Photo by courtesy of New York Times

THE CARVED CEILING OF THE JAIN TEMPLE AT DILAWAR

Jainism is an important sect of the Hindus, claiming no less than a million believers. This religion arose as a protest against Brahmanism about the same time as did Buddhism. Unlike the latter, however, it never spread beyond the bounds of India. The Jains are among the wealthiest and most influential members of the Hindu community, devoting their energies largely to mercantile pursuits.



TEMPLES AND TOMBS AT JEYPORE

Jeypore, perhaps the handsomest of the native towns of India, lies about 850 miles northwest of Calcutta. The city was founded in 1728 and is surrounded by a formidable wall. It has paved streets 111 feet wide, running at right angles to each other. It is the capital of the province of the same name.

involved and which are equally dangerous in other parts of Asia.

Let me tell you a story as it was told me by a Harvard graduate, who is now a minister of the Japanese Crown. "When Perry came here," said he, "and Townsend Harris (of blessed memory) followed him and made the first treaty with Japan, it was stipulated that we (the Japanese) should give them ground for their legation and their consulates, compounds. We did so. Yokohama was then an unimportant place, a native fishing village. It was the natural port of Tokio, but as we had no foreign trade that meant nothing. We gave them ground in Yokohama for their consulate. Merchants and traders followed, and we gave them ground also for their shops. The British and the Russians and other European nations came in and we gave them like concessions. In Yokohama, as you know, houses and stores are not numbered as you number them in America—110 Broadway, for instance—but are numbered in the order in which they were built. Thus, "Number 1 Yokohama" may be half a mile distant from "Number 2 Yokohama." This method of numbering still survives.

"Well, as time went on the village grew into a city. Under the treaty of Townsend Harris and all the other treaties the right of extra-territoriality was recognized. That is, whenever a case arose in which a foreigner was involved it must be tried by the consul of the country to which the foreigner belonged. As time went on, Sir Harry Parks, the British minister, asked for ground in Yokohama for a race-track. We cautiously suggested that horse-racing was said to be wicked by the European missionaries. But he insisted and we gave him the ground. Then we were asked for ground for a social club for the foreigners, and we gave them a plot on the sea front, the finest piece of land in the city.

"Later they wanted to play cricket and football, and finally golf. Well, we gave them ground for this. As the city grew, this cricket-field was so surrounded by buildings that it was practically in the center of town. Understand, all of this ground was donated. Last year we suggested that we could use the cricket-field, and we offered to give in place of it a field in the suburbs. As railways had been built meanwhile, the new field would be even more accessible than the old one was when we gave it. The foreigners demurred, and proposed that we buy the old field and with the purchase-money they would secure a new one. Finally, we compromised by paying for their improvements and furnishing them a new field with like improvements free of cost.

"The question of taxation arose. Yokohama had grown to be a city of 300,000 inhabitants, with millions of dollars invested in buildings owned by foreigners. We asked no taxes on the ground we had donated to them, but we did think it fair that they should pay taxes on their buildings. They said no, that everywhere in the West the buildings went with the ground. We submitted the question to the Americans, but they dodged the issue, saying they would do whatever the others did. Then, under the law of extra-territoriality, we were compelled to leave the decision to the British consul, and he decided against us. The case has now gone to The Hague Court.

"Finally, when I tell you that in the light of this history no native Japanese gentleman has ever been permitted to enter the club-house or the grand-stand of the race-track or to play upon the cricket-field, perhaps you will understand why there is some feeling against foreigners in Yokohama."

When Commodore Perry went to Japan in 1853 he wrote a letter to the Japanese Emperor containing these words:

"With the Americans, as indeed with all Christian people, it is considered a sacred duty to receive with kindness, and to succor and protect all, of whatever nation, who may be cast upon their

shores, and such has been the course of the Americans with all Japanese subjects who have fallen under their protection."

With his warships Perry compelled Japan to receive citizens of the United States and to grant them extraordinary domiciliary rights. From that day to this we have spent enormous sums to establish schools in Japan for the education of the natives. Yet we now are seeking to deny them admission to this country and we are refusing to permit them to attend our schools.

In the Philippines a ruffian American soldier, recruited from the purlieus of New York, shoves a native gentleman from the sidewalk of Manila with an oath, calling him a "nigger." Yet that "nigger" is very likely a cultivated gentleman, educated at the Sorbonne, in Paris.

The infamous opium war upon China, and the equally infamous existent compulsion of China to receive Indian opium, are outrages no whit worse than our own extortion of absurdly exorbitant damages for losses of American ships to Chinese pirates in the Yellow Sea. For many years there was no more profitable undertaking for the owner of an American clipper ship than to sell it and its cargo to the Chinese government after it had been looted by the pirates.

Such, my friends, is something of the shameful record of our relations with the Far East. In India, in China, and in Japan we have been the guests who have enjoyed their hospitality, only to rise in the morning and say to our hosts, "You must not sit at table with us." Believe me, this condition cannot endure. Politically we are in grave danger. Commercially, with their industry and their frugality, they are fast outstripping us.

They have ceased buying flour from the Minneapolis mills, because they are grinding Indian and Manchurian wheat with Chinese labor at Woosung. A line of ships is running from the Yellow River to Seattle, bringing 72,000 tons a year of pig iron manufactured at Hankow, and delivered, freight and duty added, cheaper than we can produce it. In Cawnpore, India, with American machinery they are making shoes so cheaply that the manufacturers of Lynn can no longer compete with them. The cottons and silks which we one time sent from here to Asia are now made in Japan and China.

Thus are we related to them politically and commercially. Socially they are all saying to us, "Stop cheating us; stop swindling us; stop your treating us as your inferiors who are to be beaten and robbed." Japan is crying out, "Treat us fairly and we will go more than half way. Leave to us the question whether Japanese laborers shall go to America to annoy you, and we will stop them. But do not say that you will admit the lazaroni of Hungary and Italy and Russia, simply because they are white, and shut us out because we are yellow.

The Singhalese natives of Ceylon, while I was in Colombo, addressed a remarkable communication to the Governor General. They said a hundred years ago there was established in the United States a new theory of government—that there should be no taxation without representation. "Now," said they, "we ask a share in the government of the island. We pay taxes. You may fix a property qualification and say that no one having less than a thousand pounds sterling shall share in the government. We shall not object. You may also fix an educational qualification. You may say that no one but a college graduate shall take part in the government. We will not object. In short, you may fix any qualification except a racial qualification. That would not be fair." "And what answer have you to make?" I asked Mr Crosby Rolles, editor of *The Times,* of Ceylon. "To meet their request," he replied, "would mean to turn over the government of Ceylon to them at once, because there are 6,000 of them and only 5,000 English men, women, and children. We must stop educating them."

What do you think of that for a remedy? Personally, I do not think it will work, any more than I think any rule of arbitrary repression can endure.

I take refuge in the large experience and ripe judgment of Lord Curzon, of Kedleston, who in July, 1904, was given the freedom of the city of London in Guildhall, and on that occasion used these words: "Depend upon it, you will never rule the East except through the heart, and the moment imagination has gone out of your Asiatic policy your empire will dwindle and decay."

I am also impressed with the correctness of Lord Morley's attitude. Speaking in support of the Indian reform proposals two years ago, he said: "The Founder of Christianity arose in an Oriental country, and, when I am told that Orientals always mistake kindness for fear, I must repeat that I do not believe it, any more than I believe the stranger saying of Carlyle, that after all the fundamental question between any two beings is, Can I kill thee, or canst thou kill me? I do not agree that any organized society has ever subsisted upon either of those principles, or that brutality is always present as a fundamental postulate in the relations between rulers and ruled."

And Curzon and Morley have many supporters in their view. In smug complacency, you may close your doors which look toward Asia, while you open wide those which look toward Europe; you may refuse the Oriental admission to your schools, while you accord the privilege to any child of a European; you may pile import duties mountain high, and raise our standards of living to any pitch of extravagance; you may build warships without limit, and you may continue to treat the Asian as legitimate prey. But I am confident that it will not avail.

As a soldier, whether at Omdurman, in the Sudan, or on 203-Metre Hill, at Port Arthur, the man of color has shown himself a right good fighting man; in commerce he has, by his industry, perseverance, ingenuity, and frugality, given us pause; and before the eternal throne his temporal and his spiritual welfare are worth as much as yours or mine.

SOME MEXICAN TRANSPORTATION SCENES

By Walter W. Bradley

With Photographs by the Author

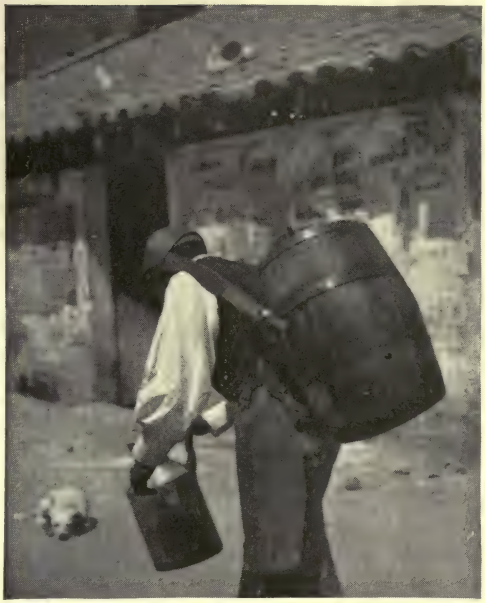
IN Mexico one may find all of the modern conveniences of travel and transport, including the Pullman, automobiles, and electric street railways; for, in Mexico City, the capital of our sister Republic, they have quite as complete and effective a street and suburban system of electric railways as is to be found in any city of the United States. While this is true, it is not the intention of the present sketch to describe any of the above modes of travel; but rather to depict some less familiar scenes, which are in part at least the relic of earlier days.

The contrast seen in these ancient and modern methods side by side is striking, at times. The writer one day on the outskirts of Mexico City while riding on an electric car passed a "peon" (laborer) carrying on his shoulder a wooden plow, such as we read of as in use in Palestine in the time of Christ. Picture 1 shows burros packing straw through the streets of the city, and was taken while passing in front of the cathedral, which fronts on the main plaza. The electric street-car tracks may be noted in the foreground.

Picture 2 illustrates the use of oxen for motive power in transportation. The Mexicans do not use a shoulder yoke for oxen, but a single stick of timber is lashed with heavy leather thongs to the

PICTURE 1. BURROS CARRYING STRAW: MEXICO CITY (SEE PAGE 985)

PICTURE 2. OX CART AT SINALOA



PICTURE 3. THE WATER VENDER

back of the animal's horns. Sometimes the yoke of the wheel span is lashed rigidly to the timber projecting from the cart; and at each roll and jolt of the cart over the rough mountain roads the poor brutes' heads are yanked and jerked to first one side and then the other.

Picture 3 is of an "aguador" (water vender), at Cuernavaca, capital of the State of Morelos, one time home of Cortés and Maximilian. The can in front of him, used for serving the water from the barrel, is also hung by a strap from his head. The Mexican peon is rarely seen carrying even the smallest package in his hands—he must hang it from his head or shoulders, or stow it inside the high crown of his "sombrero" (as in the case of small parcels). The writer has seen a peon buy a centavo or two of peanuts from a street vender, take them, loose, in his hands and toss them into the broad, turned-up brim of his hat, and stroll off down the street.

In Picture 5 may be seen another method of carrying water. The two men shown in Picture 4 have crates which are used to take farm produce and poultry to market. They have disposed of their loads in the city and are seen entering the Church of "Nuestra Senora de Guadalupe" (Our Lady of Guadalupe), the shrine of the patron saint of Mexico at Guadalupe.

The ancient method of hoisting ore in the Mexican mines was by means of the leather bag ("zurron"), one of which may be seen in Pic. 8. Though all of the larger mines are now equipped with modern machinery, the zurron may still be seen in small properties and in districts remote from the railroads. Often the zurroneros were mere boys; but they would carry their loads of 100 to 200 pounds up winzes and shafts, with only the precarious footing afforded by the "chicken-ladders" (notched poles four to six inches in diameter).

PICTURE 4. CRATES USED FOR CARRYING CHICKENS TO MARKET

PICTURE 5. WATER CARRIERS, SAN BLAS, SINALOA

PICTURE 6. TRANSPORTING A SHAFT WEIGHING 580 POUNDS TO THE CYANIDE PLANT

PICTURE 7. TRANSPORTING A JOINT OF PRESSURE PIPE FOR HYDRO-ELECTRIC POWER PLANT. WEIGHT, 396 POUNDS

The mule-back method of transporting sectionalized mining machinery is not an unfamiliar sight in the mountain districts of the western United States; but some of the loads handled in this way by the Ventanas Mining and Exploration Co. (Ltd.), in western Durango, Mexico (with which the writer was assistant manager), are worthy of illustration.

The "time-honored" mule load was 300 to 350 pounds—a "carga" consisting of two pieces or packages weighing about 150 pounds apiece, one being lashed on either side of the pack saddle. A "cuarteo" is a box or single piece, which by reason of bulk or weight can only be handled singly. In sixteen months we took into Ventanas, over 105 miles of rough mountain trails, some 1,500 tons of heavy, awkward machinery and 1,000 tons of stores and supplies. Every ounce of this went in on either mule or burro back.

It is possible, by exercising judgment in assigning loads best suited to certain animals, to handle over rough trails loads of 475 to 500 pounds, and when necessary as much as 680 pounds, in one piece.

Picture 6 shows a piece of shafting 3 15-16 inches diameter, 13 feet 6 inches long and weighing 580 pounds. Thirteen of these shafts were thus transported to the mine on picked mules, two men being

PICTURE 8. THE ANCIENT BURDEN BEARER IN THE MINES

PICTURE 9. TRANSPORTING BY MULE TRAIN: MEXICO

PICTURE 10. CARRYING 2,300 FEET OF ⅞ STEEL AËRIAL TRAMWAY CABLE ON 12 MULES (SEE PAGE 990)

assigned to each mule—one man ahead with the lead-rope, the other behind to steady the load and prevent it from swinging and see-sawing. Heavy pieces like these were handled in relays, changing mules about every two hours.

The method of handling cables is shown in Picture 10, which is of 2,300 feet of seven-eighths-inch steel aërial tramway cable on 12 mules. "The coils were made up and tied with wire in the factory before shipping, each mule-load being divided into two parts, with about 12 feet of cable between each pair of coils. The coils were so arranged that each mule-load was about 236 pounds or 144 feet of one-inch, 230 pounds or 192 feet of seven-eighths-inch, 240 pounds or 354 feet of five-eighths-inch cable. The largest piece (about 4,000 feet) of one-inch cable required 26 mules for its transport. One man was assigned to each two mules. The mule at the head of the line was controlled by a lead-rope, and each mule's lead-rope was fastened to the pack of the mule in front of it. In this way they were kept at a uniform pace, and with the men distributed as indicated the entire train could be stopped simultaneously when necessary to tighten up the cinches or for other purposes."*

Picture 9 shows a tube-mill head-plate casting (in the lead), weight 200 pounds, and a tube-mill roller bearing, 385 pounds. The latter was an awkward piece to handle, not so much due to its weight as that it rested high on the "lomillos," a small wooden crib made of four 4 by 4-inch blocks, which rests

* "Mule-Back Transportation of Sectionalized Machinery," by F. C. Robert and Walter W. Bradley, Mining and Scientific Press, May 29, 1909.

on top of the saddle. A joint of one-fourth-inch gauge, 26 inches diameter, pressure pipe (weight 396 pounds) for the hydro-electric plant is shown in Picture 8.

A total of 600,000 feet B. M. of lumber was packed from saw-mill to mine (3 days' round trip) on burros and mules. The burros handled the lighter stuff—1 by 12 inches, 2 by 4, and 4 by 4. Each mule carried from 88 feet B. M. (2 pieces of 6 by 8 inches by 11 feet) up to 117 feet B. M. (2 pieces of 8 by 8 inches by 11 feet). Two pieces of 8 by 8 inches by 11 feet would weigh from 350 to 400 pounds, depending on the extent they had been seasoned, while a few very pitchy sticks, which were actually weighed, tipped the scales at 620 pounds for the pair.

THE ISTHMUS OF TEHUANTEPEC

"The Bridge of the World's Commerce"

By Helen Olsson-Seffer

THE advantages of the Isthmus of Tehuantepec as a line of communication between the two largest oceans of the world seem to have appealed to the minds of travelers and explorers from the very earliest times. Hernan Cortez predicted that it would become the great transcontinental highway. Alexander von Humboldt, who traveled in Mexico in the beginning of the last century, called the isthmus "the bridge of the world's commerce."

Nearly half a century ago the first attempts were made to dig a canal, and many railroad schemes were proposed from time to time. The first work was undertaken by the Mexican government in 1882, but it was not until 1907 that the Tehuantepec Railroad was formally opened, after a succession of failures and after years of unremitting labor.

The road, as it now exists, is in excellent condition, and bids fair to become a formidable rival to the future Panama Canal. With good harbors at each end of the road, with modern and labor-saving machinery and appliances for loading freight, and with regular communication across the oceans, the isthmus route offers great advantages to commerce. It shortens the distance between the East and West by several days.

While the route via Cape Horn from New York to Yokohama is 19,802 miles, that via Cape of Good Hope 18,085 miles, via the Suez Canal 15,527 miles, and via the Panama Railroad 11,256 miles, the distance via the Isthmus of Tehuantepec is only 10,006 miles. This latter route makes the distance from New York to Honolulu 1,273 miles shorter than the Isthmus of Panama route. At the present day, when rapid transportation is of primary importance, such a saving of time is an item worth consideration.

RIVER OF THE WINDING SNAKE

Before the days of the pioneer and forest roads, the Coatzacoalcos River (the River of the Winding Snake), emptying into the Gulf of Mexico, was the favored highway, and dug-outs poled by dusky natives carried freight and a few passengers up and down the river and its tributaries. Here and there a narrow mule-path trailing away from the banks of the river marked the entrance to some lonely plantation or village. To-day, however, the new stands side by side with the old. Fine steel boats run on the river, but the native still poles up and down in his dug-out canoe. Good roads and mule-paths have been made

NATIVE DUG-OUT CANOES AT TEHUANTEPEC, MEXICO

Photo from Russell Hastings Millward

from one plantation to another, but the old-time ox carts have not yet been discarded.

The town of Coatzacoalcos, at the mouth of the great river, has undergone the greatest change. Once a veritable fever hole, it is now rapidly being modernized and brought into some semblance of sanitation. Long wharves jut out from the water front, and fireproof warehouses and electric cranes give to the town a business-like appearance.

About this river, the Winding Snake, is woven a curious folk-legend, which explains to the native mind the origin of the tree called the *Rabo de Lagarto,* or the alligator's tail, which tree is very often seen in that part of the country.

This legend runs thus:

Many years before man was seen upon this earth, alligators in great numbers made their homes on the banks of the River of the Winding Snake, whiling away the time in sunning and warming themselves.

The young alligators often grew restless and curious of what lay beyond, over in the woods where the monkeys and parrots chattered and the great cats wandered about. "How wide is the forest?" and "Where do the paths lead to that wind away into the woods?" were questions they were continually asking each other.

One day, while the young alligators were sunning themselves on the bank, two very strange creatures came walking by and stopped to rest near the root of a big tree. One said to the other, "Do look at those alligators. They are exactly like the alligators on the other side of the mountains, and there the foolish people believe them to be gods and feed and care for them until they grow so big and fat that they can hardly move."

With that they moved along, leaving great excitement behind them in the river, for the young alligators were resolved to seek their fortunes on the other side of the mountains. Paying no heed to the warnings of their elders, they met at a certain bend of the river the following morning and set out swimming all day up stream. When night came they were so tired that they crept out from the river to sleep among the marsh weeds. Sleeping soundly, they did not hear the water gods who suddenly came upon them. These water gods were friends of the alligators, and had warned them long ago that they must never leave their homes. So, finding that they had been disobeyed, they summoned the spirit of the hills and commanded him to take the wanderers far into the forest and leave them standing on their heads. There they can be seen to this day turned into living trees. As time went on and the little alligators did not return to their home, the old ones lost hope and began to weep, shedding so many alligator tears that the mouth of the Coatzacoalcos River has ever since been salty.

The "salty mouth" of the Coatzacoalcos, with a width of some 2,000 feet, forms a good natural harbor, and has been turned into the Atlantic port for the isthmus railroad.

ALONG THE ISTHMUS ROUTE

From Coatzacoalcos the road gradually begins to climb the Cordillera, which divides the Gulf slope from that of the Pacific. Much of the route lies through wild and beautiful country, with tall *manaca* palms (*Attalea cohune*) and forest trees topping a thickly matted jungle, and here and there a quaint little Indian village on the banks of a shaded, shallow river. The picturesque Malatengo Cañon, with its rocky chasms, is followed by the Chivela Pass, entered at a height of 735 feet above sea-level, the highest point on the isthmus.

Looking up from the bottom of this wild cañon, the walls appear almost to meet, and only a narrow strip of blue sky can be seen far above. Some days, when the Gulf wind drives the ocean clouds overhead, the cañon seems filled with mist and gloom. It is then that the wild legends and romantic tales that the Indians still tell of this region linger in one's mind.

Leaving the pass, the train crawls down the Pacific slope of the Sierra

THE TOWN OF SAN GERONIMO, ON THE TEHUANTEPEC RAILROAD, A SHORT DISTANCE FROM THE PACIFIC END OF THE LINE

Madre, running along for some distance by the banks of the Rio de Tehuantepec, then cutting off across country to Salina Cruz, the Pacific port.

Here the little Indian village of years ago has given place to a new town, built on higher ground and dotted here and there with comfortable bungalows, the homes of English residents.

Fierce "northers" rage on the isthmus the greater part of the year, and the long swell of the Pacific causes a heavy surf. As no natural shelter exists, it was found necessary to build one—an outer refuge harbor, and an inner harbor with dry-dock and wharves. This dry-dock, one of the finest in the world, and the wharves, steel warehouses, and gigantic cranes make a most up-to-date port.

It is difficult to realize the immensity of the work accomplished on the isthmus. Less than six years ago the conditions were very bad; fever and death or shattered health lurked in the forest, and heavy tropical rains destroyed in a few hours the labor of days. To one who has lived and traveled in these tropics before the advent of the steam horse, it is an odd sensation to enter a comfortable Pullman car and be rushed smoothly through the primeval tropical forest at the rate of 50 miles an hour. Humble natives with burdens on their backs stand staring at this monstrosity, which with a warning screech flashes by.

The country through which the railway runs is in many respects of great interest. The tropical nature, the many different tribes of Indians living along the rivers and in the hills, their peculiar customs and picturesque garb furnish an interesting study.

DESCENDANTS OF ONCE-POWERFUL TRIBES

The different Indians today inhabiting the isthmus, descendants of once-powerful tribes, still show enough distinctive characteristics to enable one to judge of their ancestors. The Agualulcos, Aztecs, Huaves, Mijes, Zapotecos, and Zoques are among these.

The Agualulcos and Aztecs dwell in the northern part of the isthmus. Though outwardly conforming to the Catholic religion, they still retain many of their old customs and superstitions.

Among these Indians the memory of Doña Marina, or Malinche, as the Indians called her, is still revered. Although acting as interpreter and guide to Cortez, she seems to have been greatly beloved by the Indians. In Jaltipan, her native village, there is an artificial mound about 40 feet high, called the "Hill of Malinche," and the natives, who still believe that Malinche is buried beneath this hill, contend that some day her spirit will return to sweep away the cloud that has hung over them since the Conquest.

The Mijes live in the mountains to the west, in the town of San Juan Guichicovi. They are exceedingly ignorant, bold, and rather repulsive in appearance. History classes them as having been at one time the most brutal and idolatrous of all the isthmus tribes.

The greatest ambition of a Mije is to possess more mules than his neighbor. Just why is hard to understand, as they prefer to carry their burdens on their own back.

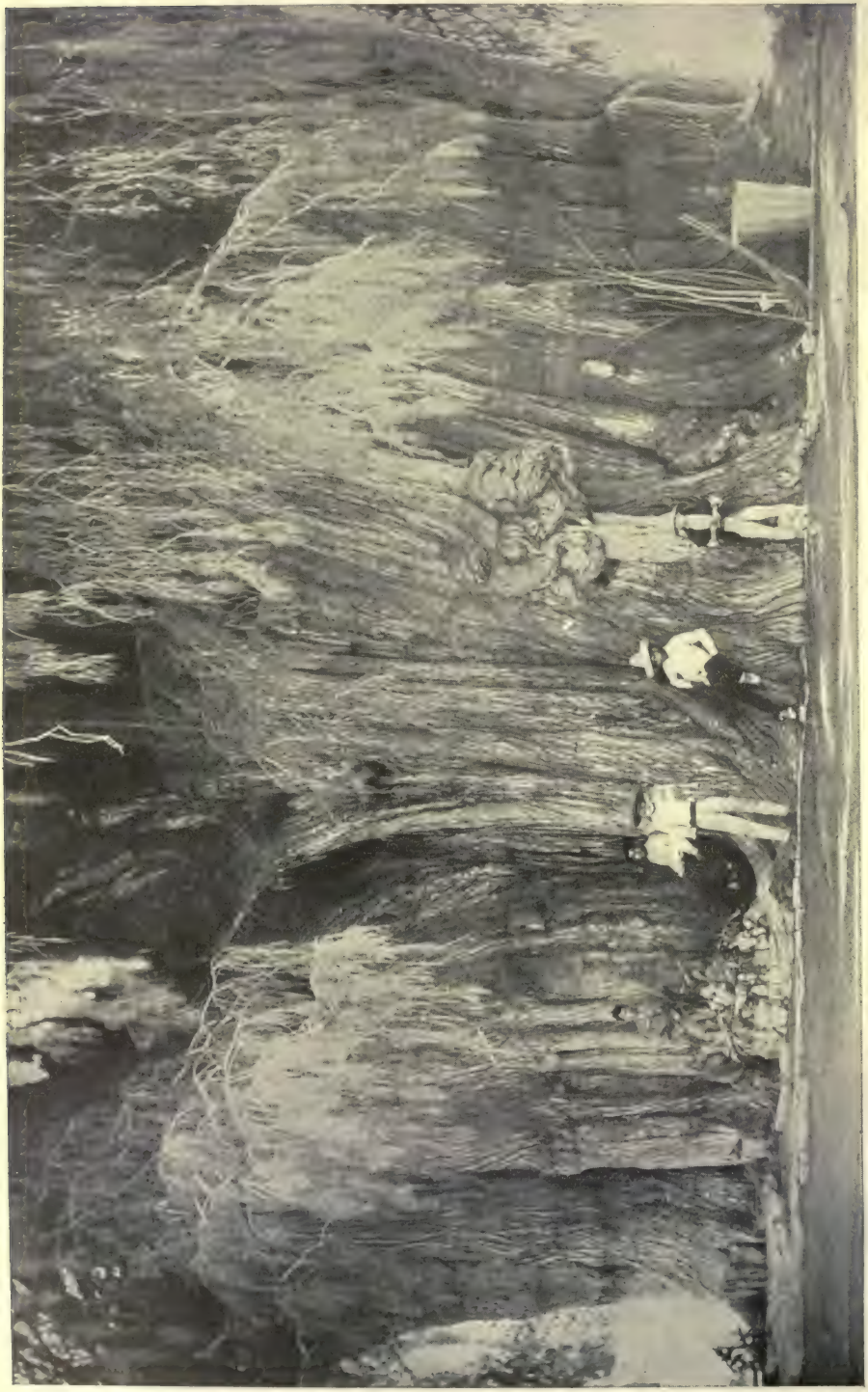
They get good crops of maize, beans, and rice from their *milpas*, which are well taken care of, but they work fitfully, are great drunkards, and very dishonest.

The Zoques, who live in the mountains between the Chichijapa Valley and the Rio del Corte, are, like the Mijes, very fond of *tequila*, the native alcohol, but more industrious, and of a more pleasing appearance.

The Huave tribe, now dwindled to a thousand or two, live in a few towns on the Pacific coast. They are very different from the other tribes, and claim to be descended from a powerful tribe in Peru.

The Zapotecos, who inhabit the greater part of the southern division of the isthmus, are hard working, gentle, and intelligent, and at one time were a highly cultured nation.

The various Indian languages are now little else than ill-spoken dialects



THE BIG TREE AT TULE, IN THE STATE OF OAXACA (SEE PAGE 1007) Photo from Russell Hastings Millward

NATIVE LABORERS Photo from Russell Hastings Millward

pieced out with Spanish words and sentences.

Somewhat below medium height, the Indians possess unusual muscular strength. They are often able to carry for several hours on their shoulders, under the rays of the tropical sun, cargoes weighing from 100 to 200 pounds. Deformed Indians among the isthmus tribes are very unusual. Their habits are exceedingly simple and their senses unusually acute, especially that of sight.

They still cling to their ancient mode of tilling the land with their primitive wooden plows. Foreign commerce, example—nothing has been able to shake their belief in the idea that their way is good enough.

The women are gracefully built, and in some tribes remarkably beautiful. With the exception of the Zapotecos, there is nothing unusual in the costume of these natives. They are garbed according to the climate, the women in heavy or light weight *cortes* and a chemise; the men in once-white cotton trousers and a shirt of the same material, with a *zarape*, if the weather be cool.

The mountain Indians wear an odd raincoat, much like the raincoat used by the Japanese peasant, made of plaited straw. These coats seem to shed the rain quite as well as our modern macintoshes, and certainly are much more picturesque.

TEHUANTEPEC, "THE HILL OF THE TIGER"

Tehuantepec is one of the important towns of the isthmus, and is mainly inhabited by Zapotecos. Its market place, "El Centro Mercantil," is always full of interest. Women of all ages sit here; tiny girls, exact miniatures of their mothers, play about.

From early morning the long, red-

tiled shed is the center of attraction. Women, children, pigs and dogs, baskets of flowers—the heavily scented gardenia and masses of pink geranium—imitation coral beads, hideous iguanas, *dulces* of many kinds, bananas and other tropical fruits—all lend themselves to the making of a scene at once picturesque and novel.

PICTURESQUE COSTUMES

The Tehuana women are beautiful. Their stately carriage, regular features, and beautiful soft brown eyes, added to their fascinating costumes, mark them with distinction and irresistible charm. They wear the usual Indian *corte,* or *enagua derollada* (rolled skirt), which is nothing more nor less than a straight piece of cotton cloth, generally one meter wide and two meters long, dyed red, blue, purple, or a checked red and white; a short chemise, or *coton,* sleeveless and with a low neck, coming just to the waist line. It is made of cotton material in different colors or of velvet, and shows to great advantage the tawny, perfectly formed arms and shoulders. The crowning touch, however, is their head-dress. Shaped somewhat like a short Japanese kimono, with a wide flounce of starched and pleated white cotton lace, it is thrown over the head so that the stiffened, lacey flounce stands out about the face like a fan-shaped frame. The rest of the garment, alas! hangs ignominiously down the back.

The more wealthy Tehuanas have a great quantity of jewelry—necklaces long enough to wind two or three times about the neck, falling down to the waist, and usually made of United States five-dollar gold pieces, alternating with irregularly shaped pearls, are the most favored. A small pendant, called *palometa,* or little dove, made of gold, and somewhat resembling the wings of a dove, often of very fine workmanship and set with pearls, is worn by almost all Tehuana women, either suspended by a bit of dirty string about the neck or a string of imitation coral beads.

Instead of baskets, the women use large calabashes, which are dried and painted, some in vivid green with gaudy flowers trailing over them, others in red, and still others in yellow. These calabashes, called "*jicaras,*" filled with fruit or other products, they balance on their heads as they walk.

NATIVE HANDICRAFT

During one of my visits to Tehuantepec, I had a lively chat with an elderly Tehuana, whose waving white hair, drawn gently back from her forehead, made a fitting frame for her regular, cameo-like features. She had come over to the market, she said, to look after the girl who was selling the cortes; she did not make much money now in the weaving and dyeing business, it was so hard to get cheap labor; times had changed greatly since she had begun her work. Noticing my interest in the cortes she had for sale, she offered to show me her home, and I followed her down the cobble-stoned street and turned into the arched doorway of a substantial adobe house, evidently quite an old place, square and one-storied, with a large brick *patio* in the center. Here in the *patio* was her work-shop.

Three young men were lazily dipping pieces of cotton cloth into large caldrons of a dark blue dye, the *anil cimarron* of the Indians (*Indigofera anil*). After soaking a sufficient time the cloth was taken out and hung on a line to dry, and, when dried and pressed, was ready for the market. This indigo coloring is made in a very simple way. Branches of the *Indigofera* are boiled down in vats until the water is thoroughly colored with the dye. It is then left to settle, the solid part of the dye sinking to the bottom of the vat. The water is drawn off and the deposit is left in the sun to dry and harden. The blue *cortes* are very commonly worn, and can be bought for from three to six pesos.

THE ROYAL PURPLE

In a room off the *patio* two men were sitting before large, old-fashioned looms weaving the much-prized purple *cortes.* Each *corte* of this purple color costs the

Photo from Mrs H. Olsson-Seffer

A TEHUANTEPEC GIRL IN HER BALL GOWN

A DANCE DURING A FIESTA IN TEHUANTEPEC

Photo from Mrs H. Olsson-Seffer

enormous sum of 20 pesos. The manner in which the thread is dyed is in itself costly and tedious, and, when woven, is well worth the price.

There is a little cove on the Pacific coast, about two days distant from Tehuantepec, where the Huave Indians go laden with skeins of coarse thread. Here they wait until the tide is far out and then paddle off in little boats to a group of rocks some distance from the shore. These rocks are covered with a certain species of small mollusks, *Aplysia depilans,* clinging fast to the rocks. The men quickly pry off and blow into the little shells, whereupon a milky, acrid, and ill-smelling fluid exudes from the animal. When they have collected enough of this fluid the thread is thoroughly wet with it and left in a sunny place on the beach to dry, subsequently being washed with soap and water, when it turns into a beautiful and permanent violet color. The Indians insist that this process keeps the thread from rotting. The men are very gentle in handling these shells, carefully replacing them on the rocks after their work is done. This mollusk is closely related to the *Lepus marinus* of the ancients, which history tells us furnished the purple of vaunted Tyre.

My hostess next took us into her kitchen and showed us her bake oven, which looked more like an Eskimo hut than anything I can think of. It was very large, all of four and a half feet high, round, and made of clay, with a large door in one side. A spotted pig with an inquiring turn of mind kept close to my heels during my stay in the kitchen, and two brown hens pecked around as if very much at home.

The parlor came next, a very neat, well-kept room, and one in which our hostess evidently took much pride. There was an upholstered sofa and two chairs, an elaborate "what-not" in the corner, covered with fancy fans and gay colored picture cards, and two or three ordinary cane-bottomed chairs. We sat down here while she showed a number of native ball costumes. These are very elaborate, especially the skirts, which are either of brocaded velvet or of plush, often with very intricate patterns of embroidery and beads. These skirts are all made in one style, very scanty, and gathered on to a band for the waist. Without exception they are finished at the foot with a pleated ruffle of stiffly starched white cotton lace about 10 inches wide. These costumes seem to be peculiar to Tehuantepec, and, though seen sometimes at Salina Cruz and San Geronimo, are only worn by the Tehuanas.

MARKS OF AN OLDER CIVILIZATION

There are many points of interest to be seen round about Tehuantepec. In a northeasterly direction, about three miles from the town of San Geronimo, is a curious painted rock standing straight up from the sloping side of the Cerro de Ixtaltepec. It is covered with quaint figures and hieroglyphics painted in red, and, though very old, these figures are still quite distinct. It is thought by some to have been a treaty rock, probably settling some dispute between two tribes in the days before the conquest. The Indians do not like to go near the rock, fearing the evil spirits that abound there. Several bright red crosses have been painted over the figures in recent years, evidently work done by the padres to drive the devils away.

A number of ruins, silent evidences of a once vast and powerful people, have been brought to light from time to time. One, a very interesting study, the mountain of Guihengola, whose summit is covered with ruins, lies about five leagues to the west of the town of Tehuantepec.

Near the summit of one of the limestone spurs of this mountain is a cave, sloping downward, with several large rooms and passages from one to the other. After a hard climb to the summit a large valley about two miles long is reached. In this valley, surrounded by a massive crumbling wall about 12 feet wide, is a large oblong structure, supposedly a temple, built of small flat stones and lime. It is 33 feet high, 90 by 105

feet at the base, and at the top 75 feet by 60 feet. Four terraces, built one above the other at a distance of six and a half feet, surround the structure. Narrow flights of steps run up to the top at each end and one wide flight in the center. This temple is believed to have been built for offering up sacrifices.

Across the valley, and directly opposite, is another and similar temple, but larger, and with houses built on top. To the south of this is another large mass of ruins, surrounded by a high wall and the ground paved with stones. The natives are full of superstitions concerning these mountains, but tradition has it that the inhabitants of Guihengola were driven away 300 years ago.

Many other remnants of an older civilization can be observed on the isthmus, where today the blending of ancient customs and semi-civilized natives with twentieth-century progress and hustle is very curious to observe.

HEWERS OF STONE

By Jeremiah Zimmerman, D.D., LL.D.

THE ruins of Mitla are the most beautiful, the most interesting, and best preserved ruins in the Republic of Mexico, although they are not the most extensive. Years before the conveniences of modern travel, explorers were attracted to them, so that the world has become somewhat familiar with these unique and remarkable structures. It is partly due to their marked distinctive character, their isolation in the solitude of the remote end of the valley, bounded by the mountains, and owing to the utter lack of information as to their origin, so far as their builders are concerned, and the time of their construction that travelers have been tempted to indulge in extravagant language when referring to the Mitlan ruins.

The extensive mural decorations of mosaic fretwork is almost as perfect as when finished, many centuries ago; but there is no written language there, no inscriptions that shed light on these unknown problems, for all is as mute as the Sphinx of Egypt, and even the records that the ancient race transmitted to their posterity, and which would be of incalculable value to us, were utterly destroyed, with few exceptions, by their conquerors as being the works of the devil who unfortunately has been made responsible for too many human, and also inhuman, shortcomings, as well as the scapegoat for some of the worst crimes of history.

In this article I shall endeavor to give a description of these wonderful ruins, based upon personal observation and the information gained from that able and painstaking explorer, William H. Holmes.

Most of the difficulties that once prevented the ordinary traveler from visiting Mitla have been overcome by the extraordinary progress in transportation, for now we can ride in a rather comfortable train, and even in a parlor car, to within 30 miles of the ruins, and the chief engineer of the Southern Railroad informed me that a branch road had been contemplated and would soon be constructed as far as Mitla. The railroad traverses a section of country that has many attractions, descending from the altitude of more than 7,000 feet at Puebla until it reaches a point where the bed of the road is only 1,768 feet above sea-level, where for several hours we run through the great canyon.

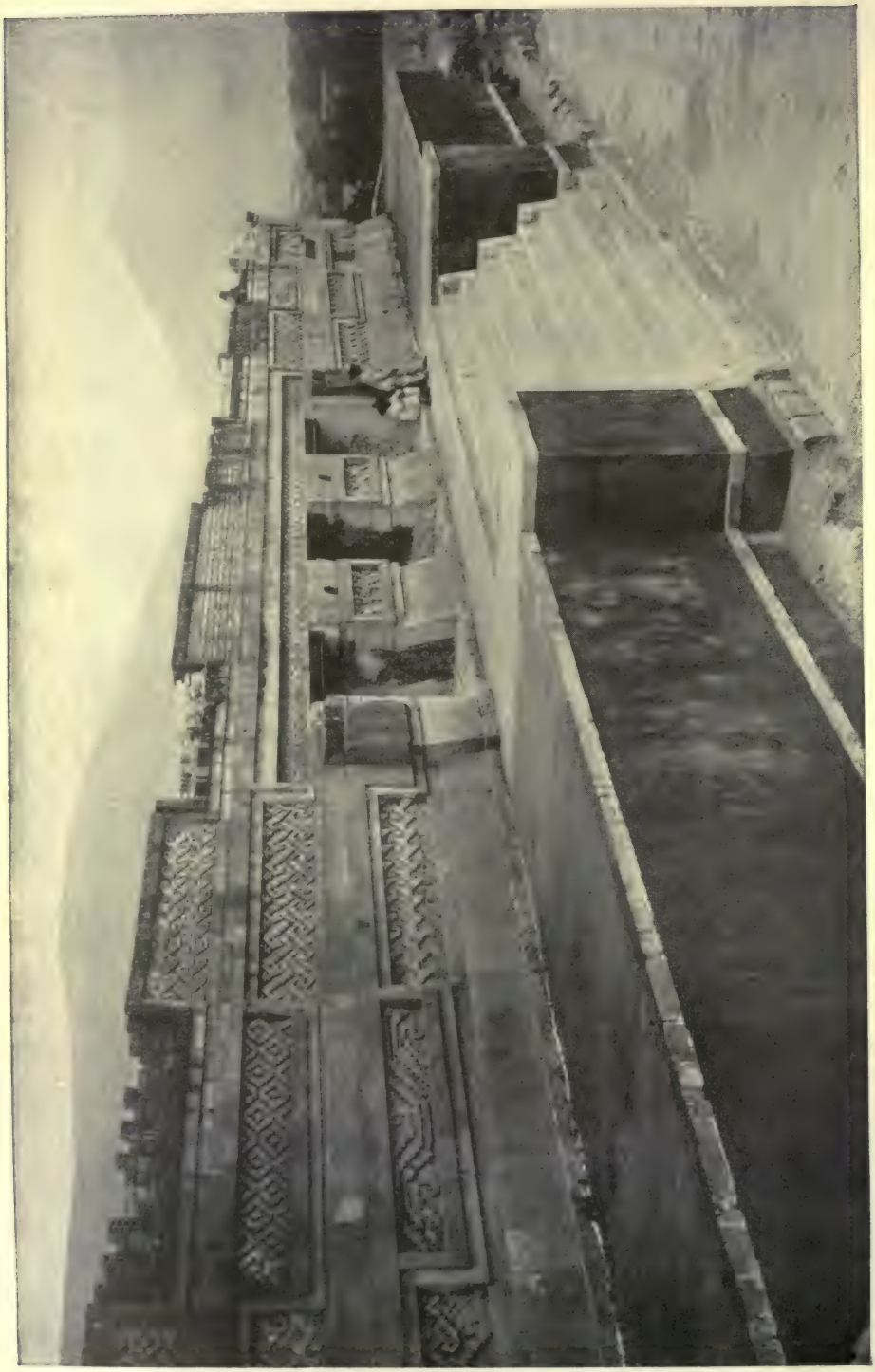
A GORGEOUS LANDSCAPE

There are features in the picturesque scenery above the road that make a lasting impression, and as memory takes us back I see again the mountains standing out in imposing grandeur, the rocky

Photo from Mrs H. Olsson-Seffer

TYPICAL ZAPOTECA WOMAN WITH THE PECULIAR HEAD-DRESS

Note the pendant on the necklace (see page 998)



MAIN ENTRANCE TO THE PALACE OF MOSAICS, MITLA (SEE PAGE 1015)

cliffs and sides streaked with the effective colors and tints that finally shaded and melted away with the native gray stone—a gorgeous landscape that nature had wrought without paint or brush, but produced by the imbedded minerals or native pigments that through the ages have slowly exuded from these castellated mountain palisades, and which remain unfading through the centuries, though exposed to the elements, not on perishable canvas, but on the everlasting mountain slope, the wonder of every beholder. Long after distance made them fade from view we realized that the mental impression was not gone, and in the gallery or chamber of imagery I often seem to behold again that enchanting masterpiece of nature's painting.

As we continued some hours southward we experienced a great change in the temperature, for we had descended rapidly from the high tableland and were passing through the canyon, and the narrow course was bounded by the lofty rocky barriers that excluded the air and seemed to attract and hold the heat. We all perspired freely, with the thermometer climbing to 115° Fahrenheit in the shade, and yet I have suffered far more from the heat at times in Syracuse with the thermometer confined to the eighties, for there is no humidity in Mexico, but the air is dry, and a physician told me that sunstrokes were unknown in that country.

OAXACA HAS MANY ATTRACTIONS

The rapid and diversified change of scenery, amid tropical plants, with that royally grand species of cactus known as the "organo," afforded constant diversion for the somewhat uncomfortable traveler. As we ascended again from the lowland to the plateau the temperature greatly improved, and before reaching Oaxaca we had reached an altitude of much more than 5,000 feet above sea-level and amid magnificent scenery. Again the road descends by gradual curves and soon we reach the city at the terminus of the line.

It is fortunate that the cities of Mexico are provided with street cars, for the cobblestone-paved streets are so rough that riding in a carriage, whilst it may be aristocratic, is anything but comfortable, and the poorest peon who occupies the cheapest seat in the very plain and unupholstered horse car suffers far less from the rough streets than the richest man who is jolted over the cobblestones when riding in style in his costly livery.

Oaxaca is a city of great interest and has many attractions that cannot be seen elsewhere. There are some famous churches, with unique and gorgeous decorations, and their resplendent designs of certain ecclesiastical wonders are a fascinating source of reflection for the student, who naturally seeks for a psychological reason for all this strange objective realism.

We found much in these leading churches that were worthy of repeated visits, but there are many other charming objects to be seen in this most interesting city, and the Museum, with its priceless treasures of antiquities from the aboriginal races of Mexico, I found to be of absorbing interest, for it was after all the most interesting and attractive place for me in all Oaxaca, and it is the center of attraction to every student of archeology and anthropology.

These remote people have long since passed away, but here at least is a tangible and visible connecting link, and we can study them in the light of their monumental remains. In many respects there are sermons in these stones, and as we reflect upon them we can read some of their thoughts and feelings, and even religious faith, as expressed in these rude and now often mysterious productions in clay and stone, but which were once altogether intelligible and which were so full of meaning to their cotemporaries.

In fact, these are their only surviving records, for the old Zapotecs and their Aztec conquerors who once inhabited this valley did not transmit to our generation a written history, with dictionary and grammar; and hence, as the sources of our information are so meager, the

ANOTHER VIEW OF THE PALACE OF MOSAICS AT MITLA, SHOWING THE ELABORATE EXTERIOR DECORATION

cotemporaneous works that have come down to us are all the more prized, even for the remotest suggestions of truth that they may contain concerning an extinct race that long ago had attained to a high degree of civilization, but whose origin and history are involved in so much uncertainty. All may easily repeat the same stereotyped questions that have been asked by the most earnest students of this science; but who can answer them?

It is true that in the market-place we may see some strikingly interesting specimens of the Zapotecan race, for these hardy, plump, bronzed Indian women are the lineal descendants, and, though centuries intervene, in many respects they are no improvement upon their remote ancestors, but have even retrograded, so far as personal ambition, enterprise, and achievement are concerned. Of course they have risen in the scale of civilization and are free from all barbaric practices, and are averse to warlike customs and would recoil with utter abhorrence from the shocking cannibalism involved in the worship of their forefathers. Perhaps even their physical resemblances are rather superficial and less marked than their contrasts, for the changed conditions and inevitable admixture of different races would cause a variation in the type.

THE DRIVE TO MITLA

We left Oaxaca at an early hour in the morning that we started for Mitla, in order to escape the rough carriage ride over the cobblestone streets. We took the trolley for several miles, as far as Tule, famous for the big tree, the largest of which I have any knowledge, with sufficient diameter for several stage coaches to drive through abreast if the center of the tree were hewn out, and there would still be wood enough on either side to support this mammoth giant of the flora kingdom.

It is a long drive, about 30 miles; but I had an excellent carriage, drawn by five horses well matched, and a much-traveled Englishman from Manchester, and with this interesting companion the way never seemed monotonous nor uncomfortable. In this I was agreeably surprised, for it had been described as beyond the endurance of the ordinary traveler, and many were deterred from undertaking the journey owing to these unfavorable reports.

I have often thought it would be a great relief to the traveling public if some of the chronic grumblers remained at home, or else were muzzled, for they do so much to disturb the peace of mind and to afflict the souls of others by telling of all the known evils that exist in the various cities you visit. In no part of the world during some years of travel did I meet such pronounced members of this class as when traveling through the Republic of Mexico. They never made the way natural and easy, but exceedingly difficult and dangerous by their tales of woe, and in every city they would tell you of the insanitary condition of the open sewers, of the smallpox that was raging, and how unsafe it was to take a street car or enter any church, store, or public place, and that severe colds and pneumonia were very prevalent, and that the latter was generally fatal for Americans, owing to the excessive altitude of nearly all the cities on the high tableland. I can imagine the terrible strain upon nervous people; and yet there is no escape from this thoughtless class, who, either from habit or limited interests, force this unsolicited information upon you. They would endure similar inconveniences of travel at home as a matter of course and without a word of complaint. They will race and endure clouds of dust when touring in the motor car at home, and all for pleasure, and call it fun; but to pass through a little dust in southern Mexico to see some of the interesting ruins of the world is too much for their endurance. In fact, they lack the enthusiasm of the genuine traveler and intelligent observer, and especially of the real student of mankind in the past, for some dust is inseparable from all archeological research, and the great explorers who

THE MONOLITHS IN THE HALL OF SIX COLUMNS, MITLA

These monoliths, like every stone in the buildings at Mitla, were cut out of the quarries and shaped by stone implements. The columns were used to support the roof to the court, the ceilings being made of beams of wood or slabs of stone. The roofs were filled with brush capped with rammed clay, similar to the method employed by the Pueblo Indians.

unearthed and brought to light the most interesting antiquities now treasured in the great museums of the world, and the many wonderful remains of the aboriginal races in this valley, and which now attract every visitor to the city of Mexico—these explorers went through, not merely days, but centuries of dust.

The drive itself is not uninteresting, for the long valley has some picturesque scenery, and at the primitive town of Tlacolula the journey was broken for a brief rest and light refreshments, and which prepared us for the remaining eight miles, which were soon covered. Here we reached the end of this beautiful valley, and about a mile from the base of the mountains that here rise on three sides, forming an amphitheater, is the site of ancient Mitla. According to Dr Seler it was the burial city of the Zapotec kings and priests, for it was the custom of these people, as well as of some of the kindred tribes, to bury their dead chiefs in caves, and the extensive caves in the mountains about may have led them to the choice of this site.

THE MARVELOUS RUINS AT MITLA

The insignificant and squalid village that we find here is in striking contrast with the civilization that reared these remarkable structures, although the inhabitants are said to be the descendants of the ancient Zapotecans.

Just why this location was chosen may be seen in its surroundings, the character of its mountain fastnesses, and its remoteness from other nations, and especially because of its water supply, the caves, and the abundant source of the choicest or most easily worked building materials.

Let us look upon these extensive ruins and study their architectural beauty, and then endeavor to transport ourselves into the distant past so as to become contemporary eye-witnesses of the workmen in the construction of these buildings. We must remember, when speaking of these ruins at Mitla, that they were built long after the stone in Europe had been superseded by the use of iron, for the Stone Age in Europe was probably several thousand years earlier than in Mexico. It would be a mistake, and we would fail in our full appreciation of these Mitlan ruins if in mind we were to transport these structures from the valley of Oaxaca to the valley of the Nile, or to Greece and Sicily, or to the colossal ruins of Rome and Baalbek, and then make the comparison with the great architectural achievements of the ancient Egyptians, Greeks, and Romans. Neither should we speak without reserve and qualification, as some are wont to do when indulging in most extravagant language, to express their admiration and wonder at what these races accomplished in Mexico, for these builders had their limitations. They would have builded far better had they been conversant with the architecture of Europe, and they would have made use of the arch and employed very different tools, but they used the knowledge and mechanical arts that they had, and when we keep this in mind we will be amazed at the wonderful works that they accomplished.

In fact, as we picture that age and the actual conditions of their civilization, it is difficult for us to understand how they built so well and reared structures that are still the admiration of the world. Whilst there are no contemporaneous records of the unknown builders to describe the character of their work and buildings, and how they cut the stones from the mountains and fashioned them in shape, fortunately modern explorers have discovered two quarries in the mountain, the one about three and the other six miles distant, where the ancient stone-cutters in great numbers once stood at their tedious and laborious work. There on the mountain range, without dynamite or any of our improved mechanical devices for tunneling or leveling the mountains, or cutting in form and polishing enormous blocks of granite, the swarthy Indian labored with the most primitive tools of the Stone Age, without steel chisel, hammers, and crowbars to overcome the resistance of

AN AUDIENCE-ROOM OPENING ON THE HALL OF THE SIX COLUMNS, SHOWN ON PAGE 1008

The builders did not use doors, but provided sockets beside the doorways for awnings. They were evidently not acquainted with the use of the arch, all doors in the buildings being surmounted by heavy blocks of stone, which weigh sometimes as much as 15 tons,

the softer material. No, he held in his hand a stone hammer, axe, or chisel, though harder than the particular rock from which he obtained his building material.

THE QUARRIES AT MITLA

We are enabled to reproduce the scene as we look upon the thousands of broken fragments and the many worn-out, broken, and rejected tools that still cover the native rocky floor of their once busy workshop, when hundreds of stone-cutters, speaking a strange language and urged on to diligent work by their masters, struck hard blows with rude hammers and axes before the native rock yielded and conformed to the necessary size and shape assigned for it in the building. The place recalls the quarry in the Lebanon Mountains, whence the colossal stones were taken for the temples at Baalbek. Of course, the Baalbek stones were greater in magnitude and the buildings were greater in height and of vaster proportions than those at Mitla, for in a wall 40 feet above the ground are three stones about 65 feet each in length and 15 feet in every other direction, whilst out in the quarry, one-half mile or more away from the temples of Baalbek, we saw a fourth stone of the same size, and almost detached from the mountain with the exception of the lower angle. These enormous hewn stones were much larger than the largest ones used in the wall around Jerusalem or in the great pyramid of Egypt. But these were different workmen who went into the Lebanon Mountains, and they had very different tools, that made the hardest granite and porphyry yield to their stroke.

While the workmen in the quarries near Mitla were restricted to stone implements, they were highly favored in the quality of the rock from which they quarried, for it was not hard granite, which would have rendered such achievements impossible, but a comparatively soft and easily cut stone of volcanic formation, and known as trachyte, but of sufficient hardness for building purposes. To have rock that was easy of cleavage and to cut into shape was of tremendous advantage to these Stone Age builders with their primitive tools, and no doubt they discovered the material before deciding upon the site of their capital. One thing is certain, however comparatively soft the native rock may have been, it has proved to be of superior quality for building purposes, for it is most durable, and even the many thousands of thin pieces that were split off have endured throughout the many centuries, and apparently have in no way suffered from the wear of time and the elements.

I would not leave the impression that the trachyte was of the same character as that singularly soft deposit found in certain places and which exists in great quantities near Palermo, and where huge blocks are cut out of the earth according to the required size for the building. A great area had been excavated, for many of the large buildings in the city had been constructed of the soft material taken from this place. It makes very cheap building material, for no time is required to hew and dress the stone, which is cut from the native bed at once into the size wanted, just as you would cut a slice of cheese, although it is much softer, more like clay. To make the test for myself, with one stroke I easily sank the axe six inches or up to the handle. Yet the stone becomes very hard when exposed to the air and is most durable, for there are no signs of crumbling or scaling off from the buildings after the centuries of wear. Such a deposit is a gold mine for architects today, and the early Mitlans would have been most fortunate had they discovered such material in their valley.

But they had a very different problem to solve, for their material had to be cut from the mountain, and this required an enormous expenditure of time and energy, for the substance was volcanic rock, and after detaching huge blocks there were great difficulties involved in getting them down to the valley, for the quarry was 1,000 feet above the plain,

and then they had to draw them some miles farther to their place in the building. It would not be a difficult feat of mechanical engineering today, with our improved conditions, but we must consider the real difficulties as they actually existed among that primitive people. On the other hand, they had an abundance of time, and labor was cheap, and in a despotic age all the workmen necessary could be pressed into service.

SOME OF THE BLOCKS WERE ENORMOUS

Enough remains in the quarries to enable us to understand their methods. In blocks still *in situ* we may see the process of leveling the upper surface of a huge portion of rock, and then cutting channels on the four sides to form a parallelogram, and next followed the under cuttings from each end, for there are blocks just as the stone-cutters left them after having under-cut away two-thirds of the block. Likely they meant to detach it by means of driving wooden wedges under the separated ends and then soaking them with water, and, possibly, hastening the process by means of a heavy lever.

We can scarcely imagine the amount of labor necessary to cut the stones for the Mitlan buildings, with nothing but rude stone tools, especially as many of these stones were tons in weight. It was a most laborious task, for the workmen had often to take many uncomfortable attitudes, and there were cramped backs and wearied arms and bruised hands.

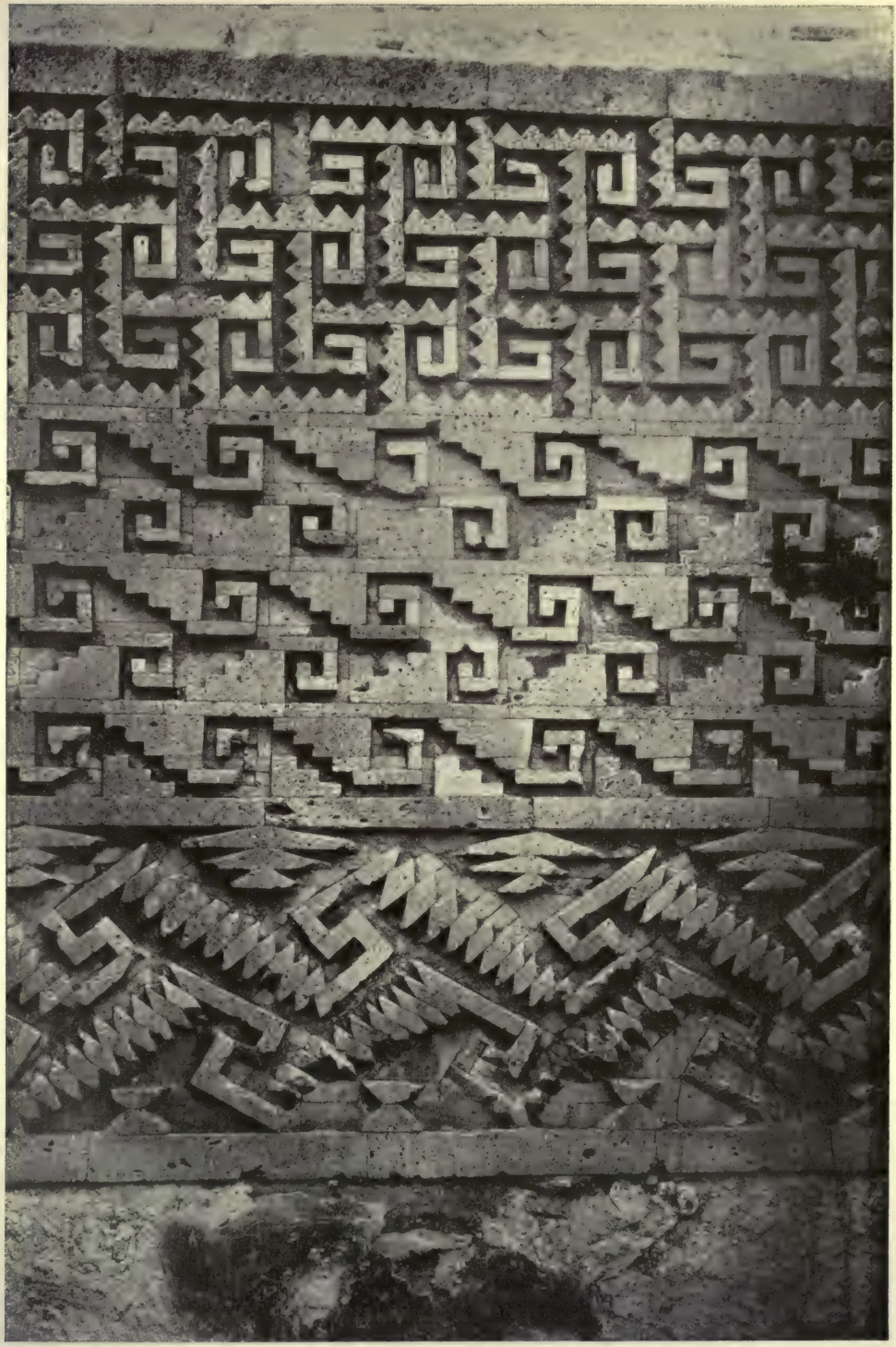
Some of the stones were of enormous size, such as the lintels, some being 20 feet in length and 4½ feet in each of the other dimensions and weighing as many as 15 tons, while the monolith columns were nearly 15 feet in length and weighed as much as eight tons. There were two heavy jambs required for each doorway, besides the sill or bottom stone, and what consummate patience and perseverance were required to provide all this building material, notwithstanding the peculiarly tractable character of the volcanic trachyte. Some 50 lintel stones remain, varying in length from 10 to 20 feet, but the original number was much greater.

THEY HAD STONE IMPLEMENTS ONLY

Holmes estimates that there were as many as 1,500 wooden beams in all the different groups of buildings as originally constructed. What infinite patience was required for these hewers of wood with stone axes. Without steel or iron, they cut the trees in the forest as best they could, and then cut them again into the required length for beams to support the flat roof.

With all our mechanical skill today, it would be child's play for our architects to rear such one-story structures as those at Mitla, for our age builds skyscrapers and tunnels and runs passenger trains through the mountains and to the summit of the Alps and under great rivers; mounts up on high and soars through space, and dispatches messages through the air to friends far away at sea, achieving wonders that the builders of Mitla never dreamed of; and we must not speak of their architectural triumphs as rivaling ours; for while it was remarkable for them in the Stone Age, and hence of great interest to us, there would be no difficulty in our duplicating it, and even greatly improving it. Therefore, we must not look at it merely in comparison with the greatest architectural achievements of ancient and modern times, but from their own standpoint, in the light of their civilization and knowledge of the mechanical arts and the character of the tools they had to work with. When we consider the conditions under which they labored, we are amazed at what they accomplished, and their triumph in architecture in the face of seeming insurmountable difficulties.

How did they cut down the trees and hew them into shape with their rude tools? Had they lived in the Iron Age and possessed steel axes, saws, planes, and chisels, our wonder would not be so great; but they lived in the Stone Age, and yet with all the serious limitations



FRETWORK MOSAIC AT MITLA, IN THE PALACE OF MOSAICS

The stone slabs or tiles are about one inch thick. It is estimated that more than one million of these stones were used in decorating the buildings at Mitla. When we realize that each stone was cut out of the quarry, not with steel or iron implements, but by stone hatchets and stone tools, the infinite labor and pains required for this form of decoration can be appreciated.

ONE OF THE LARGER TEMPLES OR PALACES AT MITLA

All the buildings in this wonderful group, excepting that containing the Hall of Six Columns, shown on pages 1004, 1006, and 1008, contain only a single long and narrow room with thick walls but one story in height. The stone blocks, though weighing sometimes as much as 15 tons, were cut out of the quarry with their hatchets of stone with such precision that very little mortar was required for the joints.

they produced a most wonderful group of buildings.

The great Hall of Six Columns is 125 feet long by 23 feet wide. These columns are about 11 feet above the floor and probably several feet beneath, and measure 3 feet in diameter at the base, tapering slightly toward the top. They are monoliths with a smooth surface and weigh from six to eight tons each. As the width of the hall was too great for the span of the flat roof, these columns were placed in the center to support the wooden beams upon which they laid the ceiling and roof, and hence this structure was very low as compared with modern public buildings. The row of columns was not intended for architectural beauty, but for a necessary support wherever the width of the room exceeded 12 feet. Some of the ceilings were formed of stone slabs, but when the width or span exceeded 6 feet, then wooden beams were employed.

THE MOSAIC FRETWORK

Every visitor to these celebrated ruins is impressed with at least one feature of originality, whereby those architects produced a wonder-effect in mural decoration by means of the mosaic fretwork. As we look upon this unique feature we may well ask whence came the suggestion or knowledge that led to this particular style of decorative work that we see on the interior walls of the rooms in the buildings at Mitla. Other buildings with similar mosaic fretwork have been discovered in several places in the country of the Zapotecs erected by the same native people; but whence did they derive their knowledge, or was it an original product or development?

Among all the architectural remains that I have seen in any country of the ancients, there is nothing that bears any resemblance to the distinctive character of this decorative work and which could have suggested it.

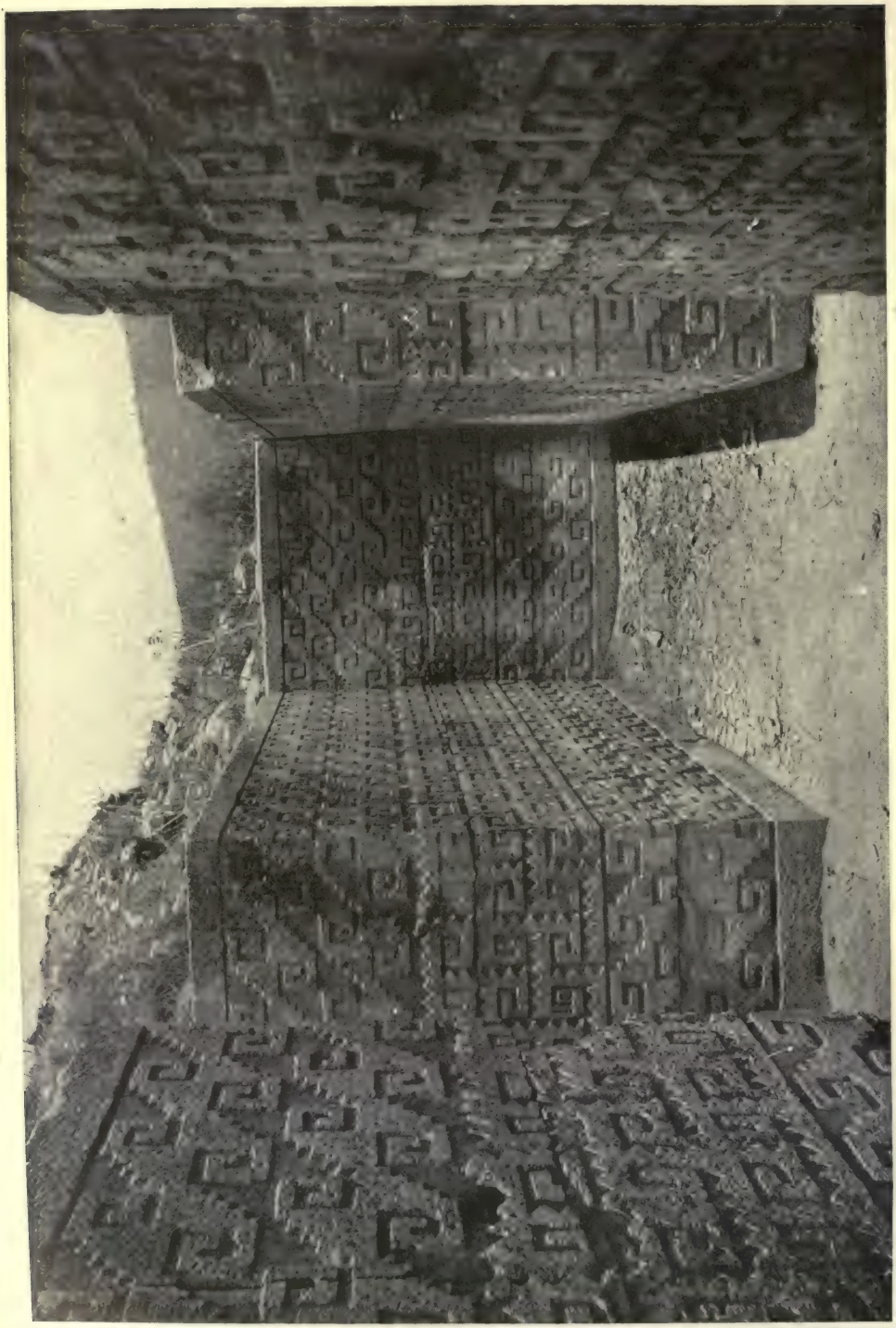
The stones composing the mosaic designs are not the small bits such as characterize the pieces that were employed in Europe, but they are rather stone tiles cut in different size and form for their particular place in the decoration, and generally from one to one and a half inches in thickness and resembling the thin bricks used in the buildings of ancient Rome.

The great quadrangle or court of grecques is 30 feet square and the walls are about 13 feet high. In addition to the doorway by which we enter as we come from the passage leading from the Hall of Six Columns, there are four other doors opening from each side wall into the four narrow halls that are parallel to the sides of the quadrangle, but of unequal sizes. It is uncertain what use was made of these narrow chambers, but they may have answered for sleeping apartments, for in those days sleeping quarters were limited in size and not the large, comfortable rooms of modern times, and where some spend most of their lives. The buildings at Mitla have no windows, the only light and air for the chambers coming from the large inner hall or quadrangle.

While the four halls that surround the quadrangle are so narrow, not more than seven feet in width, the massive walls between them and the inner court are six and one-half feet in thickness.

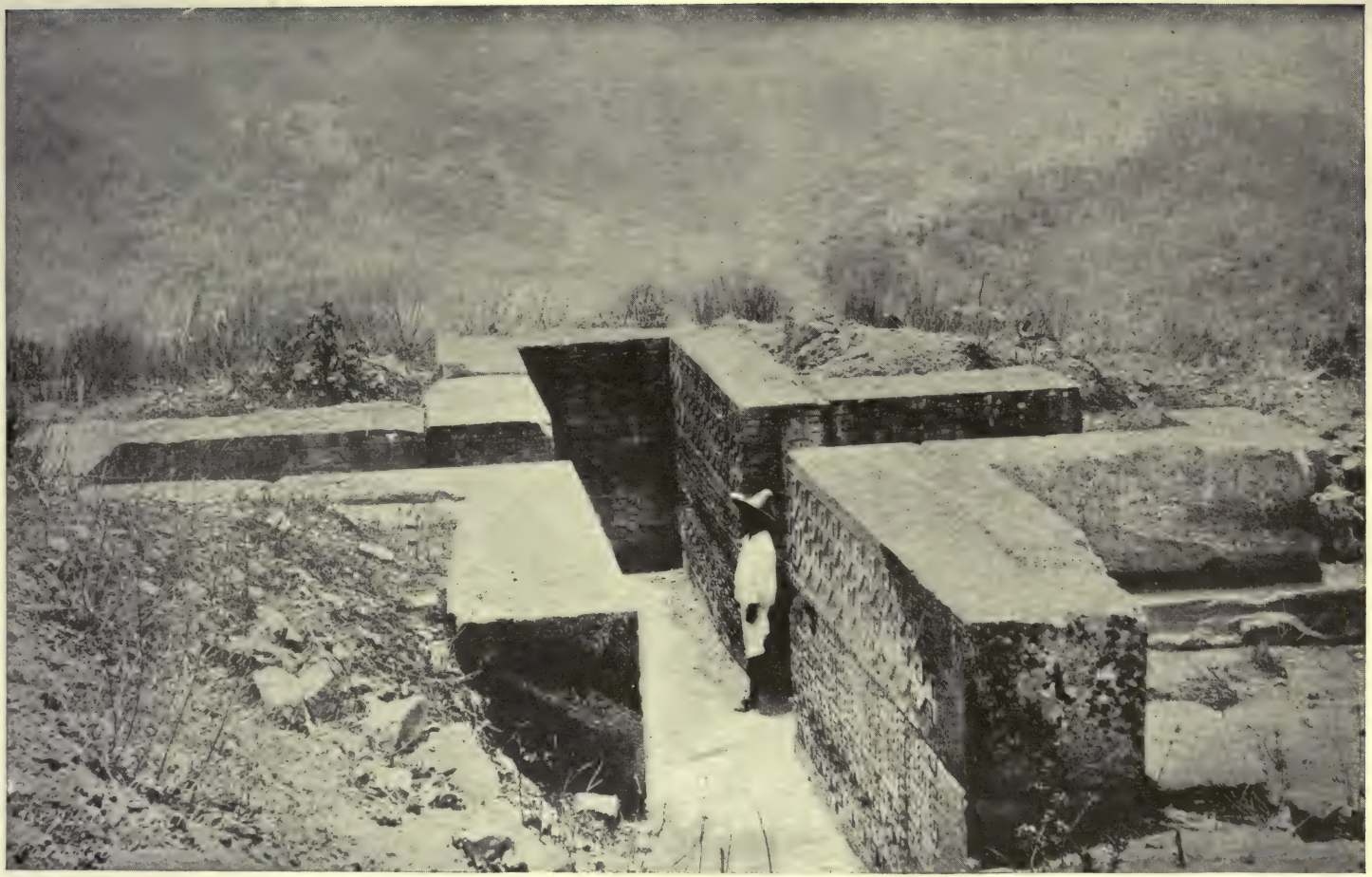
There seems to be no reason for having such a thick inner wall, for it was not for defense, and, in addition to occupying valuable space, it required many months of extra labor to cut and transport the extra stone required. The builders have given us no explanation and we are left to the uncertainty of conjecture.

Of course, in view of their lack of knowledge respecting the use of the arch, it was impossible for them to extend the mosaic decorative work over the doorway, for they were obliged to place the large lintel there instead, some of these weighing as many as 15 tons; but they were equal to the emergency, and, in order to preserve the uniform harmony of the geometric design in the mural ornamentation, they sculptured the stone lintel with the very same grecque design as the mosaic fretwork, so as to har-



THE CRUCIFORM CELLAR AT MITLA

The builders were very skillful in carving intricate designs on stone blocks, notwithstanding that their only tools were made of stone



CRUCIFORM GRAVE NEAR MITLA

Photo from Mrs Harriet Chalmers Adams

Several of these cruciform cellars have been discovered at or in the vicinity of Mitla. They probably were the sepulchres of important priests or nobles. On a hill about a mile from Mitla there are some fortifications, probably built by the same people, which in massiveness and skill compare with the ancient fortifications of Peru. Piles of rounded stones remaining on the walls show that slingers were a formidable means of defense in those days.

Photo from Russell Hastings Millward

THE TORTURE OF GUATEMOTZIN, THE LAST AZTEC EMPEROR OF MEXICO, BY CORTÉS

When his companion complains that he is being tortured beyond endurance by the fire, Guatemotzin replies, "Am I on a bed of roses?"

monize with the other portions of the walls.

EXQUISITE CARVINGS

What impressed me as most remarkable was the skill with which they carved the design into the heavy stone lintels. There was an exactness and finish in details such as we would expect from stone masons with iron hammers and chisels of steel instead of the primitive stone tools. As I reflected upon this fact the question forced itself upon me, Why did they not build or face the walls entirely of large dressed stones and then carve the entire surface with the same grecque design, and which in part they were compelled to do in the treatment of the lintel? It is true the effect would not have been as pronounced as the bold relief appearance which was obtained by the countless pieces that made up the mosaic fretwork. It might have involved even greater labor to have cut and transported the large blocks of stone from the mountain and carved out the design by means of stone tools, for they had to sculpture as many as 50 lintels, and they had no doubt learned from experience the wisdom of building just as they did.

To appreciate the prodigious labor involved, one need but estimate the number of thin brick-shaped stones employed in the mosaic work of the quadrangle of grecques alone, for they exceed 50,000. The various buildings grouped about it would have contained as many as 130,000, and it has been estimated that probably one million of these were used in the mural ornamentation of all the buildings at Mitla. The patience of the workmen must often have been tried when the almost finished bit was broken by a blow of the pick.

Father Burgoa, who saw these buildings at the time of the Spanish conquest, and when they were in far better preservation than today, has left us an interesting and valuable description, although not strictly accurate in every particular. He says, among other things, that "the palace of the living and the dead was built for the use of this one (high priest of the Zapotecs). They built this magnificent house or pantheon in the shape of a rectangle, with portions rising above the earth and portions built down into the earth." Referring to the stone columns, he states that they "are wonderfully regular and smooth. These served to support the roof, which consists of stone slabs instead of beams. But in the construction of the walls the greatest architects of the earth have been surpassed."

The Zapotecans also displayed wonderful skill in the art of painting, and, while unfortunately nearly all of it has been destroyed, yet in the examples that remain we recognize a mastery in painting that is as great a surprise as their mosaic fretwork. It is remarkable how perfect the colors remain to this day, after having been exposed to the elements for many centuries, the surface being still as smooth as polished marble. Although the figures are grotesque, according to their conception of the story which they intended to illustrate, nevertheless the surpassing coloring, the finished detail, and the general artistic effect show the presence of a master of the art.

There arises another question: Why did they not leave some sculptured figures? With such a mastery in the art of painting, and with the evidence of their skill in carrying out the grecque designs in the stone lintels, there can be no reasonable doubt as to their ability to sculpture statues of their heroes and gods; but for some reason they do not seem to have added this art to the ornamentations of their wonderful buildings at Mitla.

FOWL-SELLERS IN MEXICO

Photo from Russell Hastings Millward

Note the turkeys, which are the indigenous variety found in Mexico

AGRICULTURAL POSSIBILITIES IN TROPICAL MEXICO

By Dr. Pehr Olsson-Seffer

Late Commissioner of Tropical Agriculture to the Mexican Government

FEW countries offer better natural advantages for successful agricultural operations than the Republic of Mexico. It is true that the highlands are depending on artificial irrigation to produce abundant crops, but in the tropics of Mexico there is water enough. The rainfall varies from 80 to 175 inches, well distributed for agricultural purposes.

On the highlands the forests have been destroyed in times gone by, and devastating floods often occur; but in the "hot country," with immense primeval forests still standing, such floods are mitigated and the precipitation is absorbed by the soil to the benefit of the vegetation.

The native Indian method of corn culture in tropical Mexico does not greatly differ from agricultural practice in many other countries. The "chena" cultivation of the inhabitants of East India, the "svedjebruk" method of the early Scandinavians, the "kaski" in Finland, the "sartage" of France, and the burning off of a hillside for a "milpa," or patch of corn, in tropical Mexico are essentially similar. They are equally de-

Photo by T. F. Lee

INSPECTING CHICLE, THE BASIS OF CHEWING GUM, IN YUCATAN, MEXICO

CACAO, OR CHOCOLATE PODS, READY FOR SHELLING: TABASCO, MEXICO

Photo by Waite

Photo from Russell Hastings Millward

CACAO, OR CHOCOLATE, GROWING IN TABASCO, MEXICO

NATIVE BRICK MANUFACTURERS

The construction in this part of Mexico is, almost without exception, of brick

structive to the forest, equally ruinous to the soil. The attention of the Mexican government has been drawn to this wasteful system, which leads to the impoverishing of the people and the destruction of much valuable land.

Taken as a whole, the Mexican tropics are unusually fertile. Notwithstanding the primitive methods in vogue, the people are able to live easily. The land is capable of producing everything necessary for life, but only comparatively few products are as yet cultivated.

Detailed examinations of the soil conditions and other natural advantages in many parts of the Mexican tropics have given definite evidence of the possibilities of the country. Where there are now a few native villages, whose inhabitants are eking out a scant living, there should be large plantations and prosperous small yeoman farms. Instead of a population of a few millions in the tropical part of the country at the present time, it could support 40,000,000 people. Where there are now some $250,000,000 invested in tropical industries, $75,000,000 of which is American capital, there is room for four and five times that amount.

The government of Mexico, being fully awake to the importance of the tropical southern country, is showing its interest in the planting of industries. Experiment stations are being inaugurated throughout the land, assistance is given to agricultural societies, and commissions are granted for various purposes to improve different industries. President Diaz' administration is favoring the agricultural industries to a very great extent.

The last decade has seen much American capital entering Mexico to engage in

LOADING BURROS WITH THEIR CARGOES OF BRICK

agricultural pursuits. Unfortunately this interest on the part of the American investor has given the conscienceless promoter an opportunity of which he has not hesitated to take advantage. That this has been to the detriment of legitimate undertakings is certain. However, the public has become wise, and is now better able to discern between honest and dishonest concerns.

Every country needs tropical dependencies. Whether these are political dependencies or not is immaterial to the subject under discussion. Every country situated in a temperate climate needs a large amount of tropical produce. Coffee, tea, cacao, sugar, spices, fruits, fibers, rubber, camphor, vegetable oils, condiments, drugs, tobacco, tropical cereals, such as rice, and various starch-producing plants, as arrowroot and cassava, are imported in great quantities to northern countries. The United States have wisely in recent years acquired some tropical dependencies, to which naturally capital from the home country is diverted. But the Philippines, Cuba, Porto Rico, and Hawaii, even if developed to their full capacity, are not sufficient to supply the United States with the colonial produce needed.

American capital has therefore become interested in the production of many other countries, and principally so in those close at her door—Mexico and Central America. As tropical agriculture has proved a profitable undertaking, it is only natural that capital should turn towards these countries and towards agricultural investments. This desire for investments in the American tropics is becoming more and more evident, and Mexico is now getting her share of this outflow of capital.

THE COFFEE INDUSTRY IN MEXICO

Although the competition with Brazil is keenly felt by coffee planters throughout Mexico and Central America, coffee-growing has not decreased as an industry in Mexico. This fact is ascribed to the superior quality of most of the Mexican coffees, which can find a good market despite the reduction in price of coffees from other countries.

Coffee in Mexico is generally grown at an elevation of 2,000 to 5,000 feet. In certain districts the coffee plantations are

situated below 1,000 feet, but it is a recognized fact that coffee grown at such low elevations is inferior in quality. The only redeeming feature is that the quantity produced is so much greater, which compensates the planter for the lacking flavor and consequent lower price.

Under the present conditions of the world's coffee market, it is not very likely that the area under coffee in Mexico will be greatly increased. One of the most important factors in coffee culture is the supply and price of labor. A coffee planter needs his laborers only during a certain part of the year, and he then requires cheap labor for the picking of his crop. Labor in Mexico is becoming expensive, and it is, moreover, very scarce. By expensive labor on plantations is meant labor that is paid 50 cents per day, which generally is considered too high for crops such as coffee.

CACAO, THE FOOD OF THE GODS

In olden times much more cacao was grown in Mexico than at present. The Aztecs prized cacao very highly, and beans of this tree were used as money until the time of the conquest, when gold became the means of exchange.

Cacao has been grown in Mexico, especially in the State of Tabasco and in the Soconusco district in Chiapas. So well known were the productions of these parts of Mexico that two kinds of cacao became world renowned under the names of tabasco and soconusco. In Chile and Peru cacao is still named soconusco, and it is a mark of honor to be invited to a cup of "soconusco." This Soconusco cacao was sent to the King of Spain among the contributions from the viceroyalty of Mexico. Until some 30 years ago Soconusco cacao retained its name for superiority and regularly occurred in the market. Today a very small quantity only is grown in that district, and the total production is consumed locally.

The reason for the discontinuance of cacao cultivation in Soconusco was mainly the indifference and indolence of the natives. The district was opened up and opportunities for making a living became more varied. The native does not care to bother when he can make sufficient for himself and family by working two or three days of the seven in the week.

In recent years the culture of cacao has been stimulated by the high prices of this product. Several foreign companies and individual planters have begun to devote attention to this crop, which promises to become one of the most profitable products of the soil, although it takes some six or seven years until a full crop is obtained after planting.

TEA-GROWING

This industry has as yet made no headway in Mexico. One or two American companies have gone into this kind of planting, but their example has not been followed. The main reason of this indifference is probably the general prevailing ignorance of the subject of tea-planting.

Experiments and investigations of the conditions for tea-growing in Mexico have shown that an excellent quality of tea can be grown in many districts. The planters in Ceylon, India, and Java, as well as the native farmers of Japan, Formosa, and China, are making a good thing of their tea gardens, and there is no reason why considerable areas in Mexico should not be put under this crop.

The consumption of tea in America is considerable, and with an open and good market at their very doors, Mexican planters should realize their opportunity in this regard.

SUGAR-CANE

The sugar industry in Mexico dates back to prehistoric times. Different sweetmeats have always been in great favor with the natives of the country, and they were made from the home-made "panela" sugar, which is still being manufactured in the tropics of Mexico in the old primitive way, by grinding the cane between upright wooden cylinders drawn by a team of oxen, and boiling the sugar in large open pans.

Very few improvements are applied by

A LUXURIOUS VANILLA VINE: THE LONG FLESHY PODS MAY BE DISTINCTLY SEEN

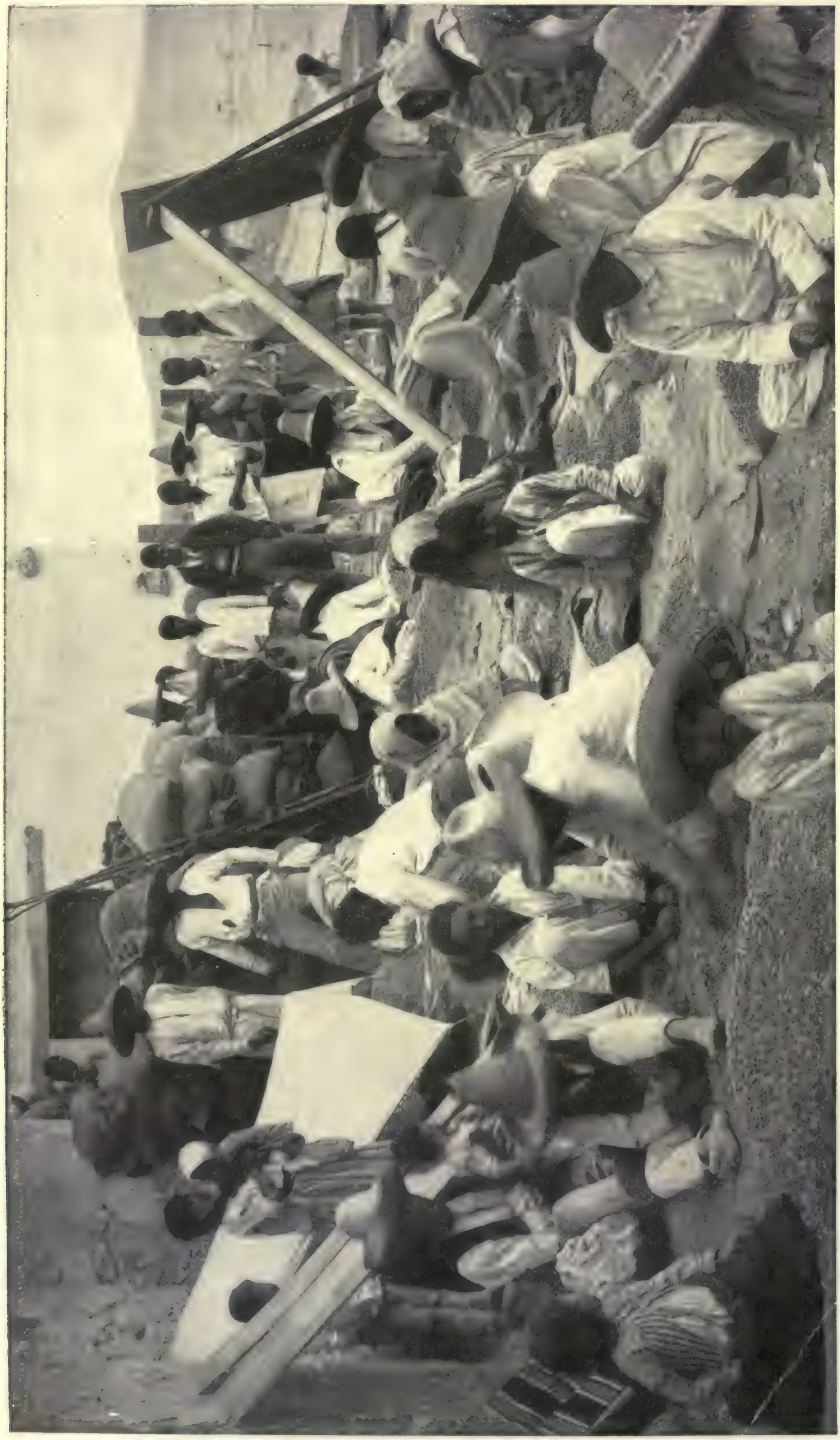


Photo from Russell Hastings Millward

SORTING BEANS IN MEXICO

the natives themselves, but on the large haciendas, owned by the descendants of the Spanish invaders, modern machinery is in use. Many foreign companies and capitalists have invested in sugar-cane properties, but it may generally be said that the sugar industry is not nearly in the high grade of development which characterizes the sugar plantations of, for instance, Hawaii.

Very little attention has been given to improvements of the varieties of cane grown, and it is not unusual to find large plantations of native cane low and thin and containing only a low percentage of sugar. The same land, if cultivated properly and planted with better varieties of cane, is capable of producing twice the amount of cane and nearly three times as much sugar.

In the milling methods many betterments could be effected. Very few Mexican sugar mills employ a chemist, and with the rule of the thumb system employed much is lost in the manufacturing process.

Certain parts of tropical Mexico have excellent soil for sugar culture. If proper modern methods of cultivation were adopted, fertilizers used, and an intelligent system of irrigation practiced, Mexico could double its sugar production from the area now under cane.

The total production of sugar in Mexico is only little more than the consumption within the country. The communications are good from Mexican ports, and the country could well enter into competition with other cane countries in the world's market. To do so it needs men with knowledge and capital to invest in sugar culture.

OPPORTUNITIES IN SPICE-GROWING

Cultivation of spices has been neglected in Mexico. Among the few that are grown are pimento and ginger, but neither is of any importance in the production of the country. Chillies, however, are grown in quantities, but mainly consumed within the country, being the principle spice used by the Mexicans of all classes.

Jamaica is the only country whence pimento or allspice is exported at present. As it grows on even a very poor soil along the seaboard slopes, there is no reason why its cultivation in moderate quantities, allowing some export, would not be successful in Mexico.

The ginger plant has been distributed to all tropical countries, and is found in many parts of tropical Mexico growing without attention or care. There are many tracts of Mexico where ginger could be grown at a profit.

The nutmeg tree, which furnishes the nutmeg and mace of commerce, has been tried with success in Mexico, but its culture on a commercial scale has not been undertaken in this country. The localities suitable for this industry are, moreover, very limited.

The clove tree has been cultivated for many years in the West Indies, and it grows well in parts of tropical Mexico.

Cinnamon is extensively used in Mexico, as in all Latin countries, but its cultivation has not been undertaken in this country. The Ceylon cinnamon tree has been grown experimentally and succeeds well. In certain coffee districts in southern Mexico cinnamon-growing would doubtless be profitable, at least to the extent of furnishing the home market. Besides its use as a spice, cinnamon produces the cinnamon oil of commerce, for which there is always a limited market.

Cardamons would also be suitable on a small scale, and pepper culture would offer sufficient inducement to a few growers.

A VARIETY OF TROPICAL FRUITS

Mexico produces most of the fruits occurring in the tropics. The quantity grown is so insufficient, however, that very little is exported, and even within the country it is very difficult to get tropical fruits in the town markets. What is sold is very inferior in quality, showing that no care has been bestowed on the raising of the fruit.

Bananas are grown all over tropical Mexico, but systematic cultivation for export purposes has only been begun within

Photo from Chas. Kirby Fox

LOADING SUGAR-CANE: EL DORADO, SINALOA

LABORERS RETURNING FROM THE SUGAR-CANE FIELDS, SINALOA

Photo from Chas. Kirby Fox

DRYING THE HENEQUEN FIBER OF WHICH ROPE IS MADE, MEXICO

the last few years. Good communications and nearness to market are essential requirements for a banana industry. Such conditions, combined with good soil and sufficient water, are to be found in many locations in Mexico. The Tampico district is probably the best, but the coast lands of Tabasco and Vera Cruz, on the Atlantic, and of Chiapas and other coast States on the Pacific, are suitable.

Excellent pineapples are grown in Mexico, and the possibilities in this fruit are great, as it can be shipped fresh as well as canned.

Cashew nuts are grown in the extreme south; jujubes occur in places; the orange berry, or limoncito, the pomegranate, and the guava are no strangers, and the sapote chico, or sapodilla, is one of the most appreciated fruits in the country, as well as one of the commonest. The ground cherries, or "tomates de brihuega," are found in many native gardens; the tuna, or fruit of the prickly pear, is a favorite fruit in Mexico. Mulberries are widely planted, and the mango reaches perfection in certain districts, especially the variety known as the Manila mango. Were this fruit grown in sufficient quantities to be exported to the United States, it would certainly become a favorite in the market. At present not enough is grown to furnish sufficient fruit for home demands.

Of the various citrus fruits, oranges do well, lemons are grown in quantities, and limes, citrons, and grape-fruits are commonly cultivated.

The papaya, or papaw, is another tropical fruit which is easily cultivated and has a ready sale. Mexico has better varieties of this fruit than probably any other tropical country.

The breadfruit tree is grown in the south of Mexico, but very little used for culinary purposes. The various anonas, as the custard apple, the sweet-sop, and the sour-sop, are only sparingly cultivated.

The avocado, or alligator pear, is grown to perfection in Mexico, especially in Tabasco, and would form a valuable article of export if produced in larger quantities.

In regard to fruit-growing generally in the tropics, much could be done by small capitalists, especially if several combined for coöperative export.

MEXICAN FIBERS

Mexico is essentially a country of fibers. The henequen, or sisal hemp, production of Mexico is enormous, and many millions have been made by the henequen planters of Yucatan, which is the chief seat of this industry.

Pita fiber and ixtle are two other fibers well known as specifically Mexican, and the zapupe has recently come to notice. Cadillo fiber occurs wild, and has not yet been grown to any extent. Its high price in the market should, however, warrant its cultivation.

Cotton is grown in northern Mexico, and recently the introduction of the hybrid Caravonica cotton from Australia has revived the interest in cotton-growing in the Mexican tropics, especially on the Pacific slope, which is eminently suited for this purpose.

RUBBER-PLANTING

Few tropical industries have received more attention in late times than rubber. The spreading use of this commodity in connection with electricity and in the bicycle and motor tire industries, has raised the price to a high level, and consequently rubber culture is being studied all over the tropical world.

Mexico has until recently been leading in regard to the area planted in rubber, but the development of the industry in this country has been somewhat retarded on account of the many promotion schemes of imaginary rubber plantations which have been sprung upon the American public.

The large yields which the rubber tree produces are, however, sufficient to induce capital to take up this industry, although the time of waiting for returns on the investment is very long—as much as six and seven years.

The investigations and experiments of the last few years of the methods of cultivating and preparing rubber have placed the industry on a firm footing.

MASKS FOR SALE FOR A FIESTA IN A MEXICAN TOWN

Photo from Russell Hastings Millward

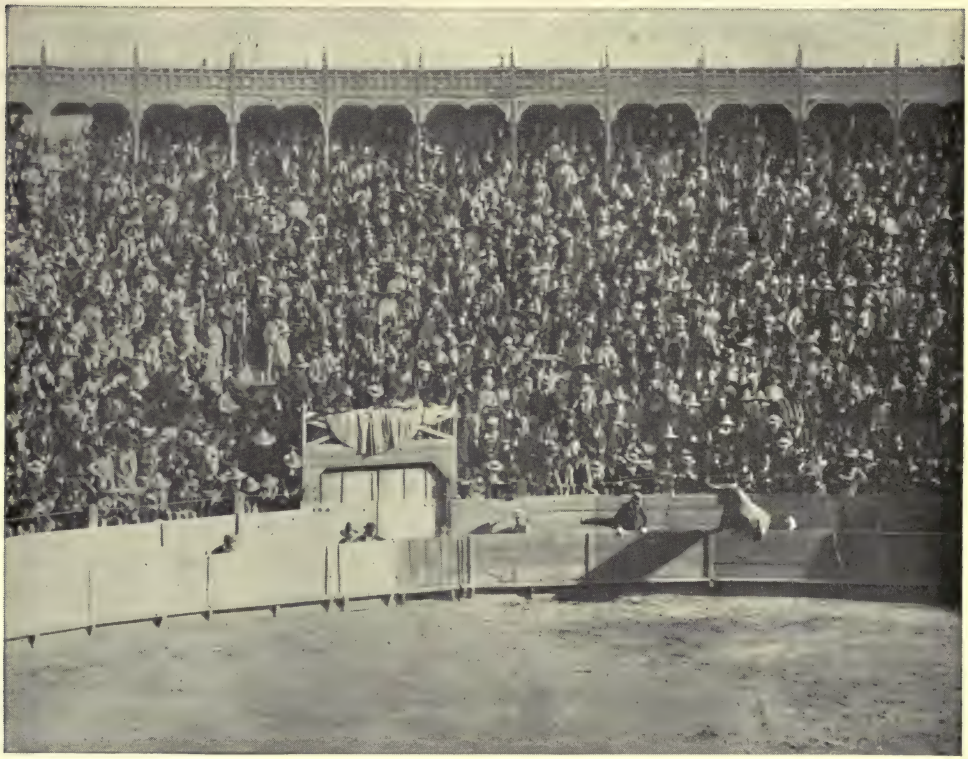


Photo from Mrs Harriet Chalmers Adams

AN ANXIOUS MOMENT: MEXICO

The details of the industry are now quite well known; there is no need of costly experiments, but the rubber planter can develop his estate with as much certainty as a coffee or cacao grower.

Growing of camphor has only been experimented with in Mexico, but many planters have recently become interested and small plantings are being made in various parts of the country, so that in a few years there will be sufficient to crop. Camphor cultivation promises to become a very important industry, as camphor is being used to a great extent for industrial purposes. Mexico has large tracts of mountain lands in the tropics suitable for this industry, and is only waiting for capital and enterprise.

PROTECTION FOR FOREIGN INVESTORS

Law and order are well upheld in Mexico—better than in many countries claiming a higher degree of civilization. The traveler is perfectly safe in any part of Mexico. Where trouble has arisen it has been upon the provocation of the traveler and stranger, who has not taken into consideration the peculiar customs of the country, but has wanted his own way, whether this has been in accordance with the desires of the natives or not.

Foreign investors in agricultural properties are well protected in Mexico, whether the investment is made by private persons or corporations. The latter need not be Mexican corporations, but it is always safer for a foreign company to be legally registered in Mexico. Land titles are not always good, and the purchaser of agricultural land in the Republic should take good care in having the documents properly investigated by reputable lawyers practicing in Mexico.

Photo from Mrs Harriet Chalmers Adams

THE POPULAR DIVERSION AMONG THE UNEDUCATED CLASSES: MEXICO

Photo from Mrs Harriet Chalmers Adams

A CONSIGNMENT OF FIGHTING COCKS

Note the specially constructed basket, with its padded sides. Only specially bred cocks are treated with such consideration

YAQUIS WAITING FOR TRAIN TO YUCATAN, MEXICO Photo from Franklin Adams

Owing to the continual disturbances of the Yaqui Indians the Mexican government transported a large number of them from Sonora to Yucatan

Photos from Mrs Harriet Chalmers Adams

LOADING YAQUIS FOR YUCATAN, MEXICO

A GROUP OF YAQUI INDIANS

STREET SCENE IN ALAMOS, SONORA, A TYPICAL MEXICAN TOWN

Photo from Chas. Kirby Fox

AN INTERESTING VISIT TO THE ANCIENT PYRAMIDS OF SAN JUAN TEOTIHUACAN

By A. C. Galloway

BOARDING the train that leaves Mexico City at 7 a. m., the traveler arrives at San Juan Teotihuacan soon after 8 o'clock. There is also a good automobile road which is often chosen by visitors.

In Egypt he would be greeted with the cry of "Change cars for the Pyramids." Here we were met and escorted to a handcar on a short narrow-gauge road used by the government during its present work, which, propelled by four soldiers, was soon in rapid motion. Once out in the open, we enjoyed the mode of transit while inhaling the fresh, crisp air of a cool January morning. As seen from the train, the pyramids appear almost insignificant, and only by near approach are the ambitious heights to be appreciated.

We passed first through what is known as the Casa de Sacerdotes (house of the priests), showing remarkable walls, terrace, and stairway of 13 steps, all in excellent preservation. Different sections are to be seen open to the light of day after centuries of darkness. Canals cut in the walls show their uses as conductors of water, while portions of decorations and designs on the walls still exhibit most beautiful tones and shades of colors, in the mixing of which time has not given away the secret.

There is also a subterranean dwelling which we went through, and this is almost entirely excavated. As the guide led us from room to room with lighted candles, drawing attention to different things of interest, we wondered what were the secrets that had remained hidden for so many centuries, and why the choosing of a house built underground. The holes in the walls at the entrance show how security was assured, much as in the present day in primitive structures of the Indians. Imagination conjures up many pictures and peoples once again these silent chambers with the moving figures of a by-gone race, but such an impenetrable mist of fable envelopes the early history of Mexico that scientific investigation as well as archeological research have not yet lifted the veil to disclose the secret of these pyramids nor who were the builders, although it is asserted by historians that they were constructed by the Toltecs, while others claim that they were built by the Totonacs, pre-Toltec in history. All refer to them as a great religious center.

It may here be of interest to observe that the Toltecs are traced to have settled in the ancient city of Tula (near the capital of Mexico) about the year 674 of the Christian era. This enables the reader to form an idea of the centuries that have passed since the construction of the pyramids, if conjecture alone can be accepted as history.

Certain it is that the pyramids of Teotihuacan, as well as that of Cholula, have kept their heads above the vomiting of angry volcanoes for numberless centuries, while it would appear that the cities near by were without doubt buried in those bygone ages by volcanic eruptions. The Toltecs were by tradition famous mound-builders, and here it seems they mingled with their reverence for the Supreme Being the mythical religion of astral worship. Their earliest temples were devoted to the sun. The moon they worshiped as his wife and the stars as his sisters. No image was allowed within these temples, and their offerings were perfumed flowers and sweet-scented gums.

Going some distance in an opposite direction, we entered a fine grotto. On the occasion of the visit of President Diaz and party, it was converted into a banqueting hall, and the effect was

THE MOST COLOSSAL STRUCTURE OF PREHISTORIC MAN IN AMERICA: THE PYRAMID OF THE SUN (RESTORED): TEOTIHUACAN, MEXICO

"In the magnitude of its remains and in the evidence the site furnishes of population and antiquity, Teotihuacan stands easily at the head of the ancient cities of Mexico. It lacks the well-preserved, sculpture-decorated buildings found elsewhere in Mexico and Central America, but this is doubtless due to the rarity of suitable building stone in this part of the valley. The famous structures of Mitla, Palenque, Uxmal, and Chichen-Itza, had they been built of such materials as are here available, would today be mere rounded heaps of débris."—W. H. HOLMES.

VIEW OF THE PYRAMID OF THE MOON FROM THE TOP OF THE GREAT PYRAMID OF THE SUN

There are nearly 200 mounds surrounding the pyramids of the Sun and of the Moon, which probably in ancient times were crowned by temples and public buildings

Photo from Mrs Harriet Chalmers Adams

HATS AND BASKETS FOR SALE: MEXICO

grandiose as well as historical. Owls and strange night-birds fly in and out and build their homes behind columns of lava, and these in rude, strange eloquence seemed to express their disapproval of our momentary invasion.

Soon we stood at the foot of the highest pyramid, "El Sol," which has so recently been bereft of the mantle of grass, underbrush, and trees that for centuries had covered it. Looking upward, we realized the infinite labor that has shown to the world of today the arduous task of the ancient Toltecs, and the pyramid, like a sentinel of time, stands as an imposing monument, Sphinx-like in its impenetrable mystery and silence, hiding within its depths those secrets yet to be discovered.

The projecting stones, seen here and there over the pyramid, mark the upward progress of those indefatigable workers until they gained the summit of their ambition. The pyramid was divided into stories by placing a series of truncated pyramids one above the other.

Two hundred and sixty-eight steps must be climbed to reach the summit. The pyramid is 216 feet in height, and has a base about 761 feet square. The summit is 59 by 105 feet square. Now and again on our way upward we found a few minutes' rest desirable, while others of our party remained half way until our return. Some distance up there is a stairway that calls much attention and evidently leads to the very bowels of the pyramid. What secrets may it divulge as the excavation is followed deeper and deeper? Perhaps some hidden sarcophagus of Toltec priests and their people, or a tomb of ancient Toltec kings; but all is conjecture and therein lies the mystery and charm of the pyramids. President Diaz expressed great interest in this stairway on his visit to the ruins some time ago.

Many strange idols have been dug up—Dioses of grotesque form and many others. Many beautiful pieces of jade and obsidian, arrow-heads, little heads of burnt clay, earthen jars of antique form, and others similar to those in use at the present time. One little piece of cloth that was found is carefully guarded in the museum. What was its use? Many skulls, as well as some skeletons, have also been unearthed.

The general theme of the stone tracery yet discovered is the emblem of the sun, its rays being especially noticeable in all carvings and designs—significant of their religion, "the astral worship."

Photo from Mrs Harriet Chalmers Adams

AZTEC CALENDAR STONE IN THE NATIONAL MUSEUM, MEXICO CITY, MEXICO

The ancient Mexican year, like ours, was 365 days, but it was divided into thirteen months. The face in the center of the above picture is the "God-Star" throwing his light over the earth, which is represented by the tongue projecting from his lips.

Having reached the summit, we were richly rewarded, for a fine expanse of country lay unfolded to our gaze, with just a peep of the snow-capped volcano Popocatepetl far in the distance, while yonder the little town of San Juan appeared sleepily dreaming under the shadow of the pyramids. Turning to the right, not far distant stands the Pyramid of the Moon (la Luna), smaller than the one we have just ascended, but looking very green and attractive, covered yet with its mantle of grass, heavy underbrush, and trees, through which is clearly defined the little pathway we shall soon tread, as so many travelers have already done. This pyramid will gradually undergo the process of regeneration, and in the course of months will appear bereft of its covering and stand in clear outline against the azure sky, as does its mate, "El Sol."

Photo from Mrs Harriet Chalmers Adams

STREET IN GUANAJUATO, A TOWN NOT FAR FROM MEXICO CITY

But to many there is a beauty in the soft covering of innumerable centuries, which for the preservation of the monuments must now be swept away. It enhances the ruggedness of man's efforts in his ambition to construct such enduring monuments, and softens, with its gentle touch, every stone and corner. "La Luna" is 150 feet high, while its base is 170 by 142 feet.

Between the two pyramids the eye traverses the street of the dead (el callejon de los muertos) until the "Salon of Agriculture" is reached, where behind

glass cases some remarkable designs and colored archeological treasures are guarded. The ancient Toltecs were artists in the beautiful shades of color they used, which are still visible, especially the pinks and greens. In another direction we observed what is said to have been the "citadel" of this buried city, showing a large mound surrounded by fifteen smaller ones. All of these will eventually be excavated.

In all there exist 180 mounds surrounding the two large pyramids, which are to be treated similarly and their preservation thus assured. Looking over the scene, one harmonizes the purposes of these with the environment. Some of them were forts for defense; some of them were religious, with their court of women, court of laity, and other societies. If only on some bright, sunny day the pageant could return, as we picture it during the Toltec dynasty, what a remarkable sight it would afford! Every terrace filled with strange people, with strange costumes in which gold and silver and the gaudy plumage of tropical birds lent their willing service.

But in the words (which history has preserved to us) of the great King Nexahualcoyatle, King of the Toltecs, whose death took place about the year 1470, we find an answer: "All round, the world is but a sepulchre, and there is nothing that lives on its surface that shall not be hidden and entombed beneath it. The things of yesterday are no more today, and the things of today shall cease perhaps on the morrow. These glories have all passed away, like the fearful smoke that issues from the throat of Popocatepetl, with no other existence than the record on the page of the chronicler. The great, the wise, the valiant, and the beautiful, alas! where are they now? That which has befallen them shall happen to us and to those that come after us. The horrors of the tomb are but the cradle of the sun and the dark shadows of death are brilliant lights for the stars."

The mystic import of this last sentence, says Prescott, seems to point to that superstition respecting the mansions of the sun which forms so beautiful a contrast to the dark features of the Aztec mythology.

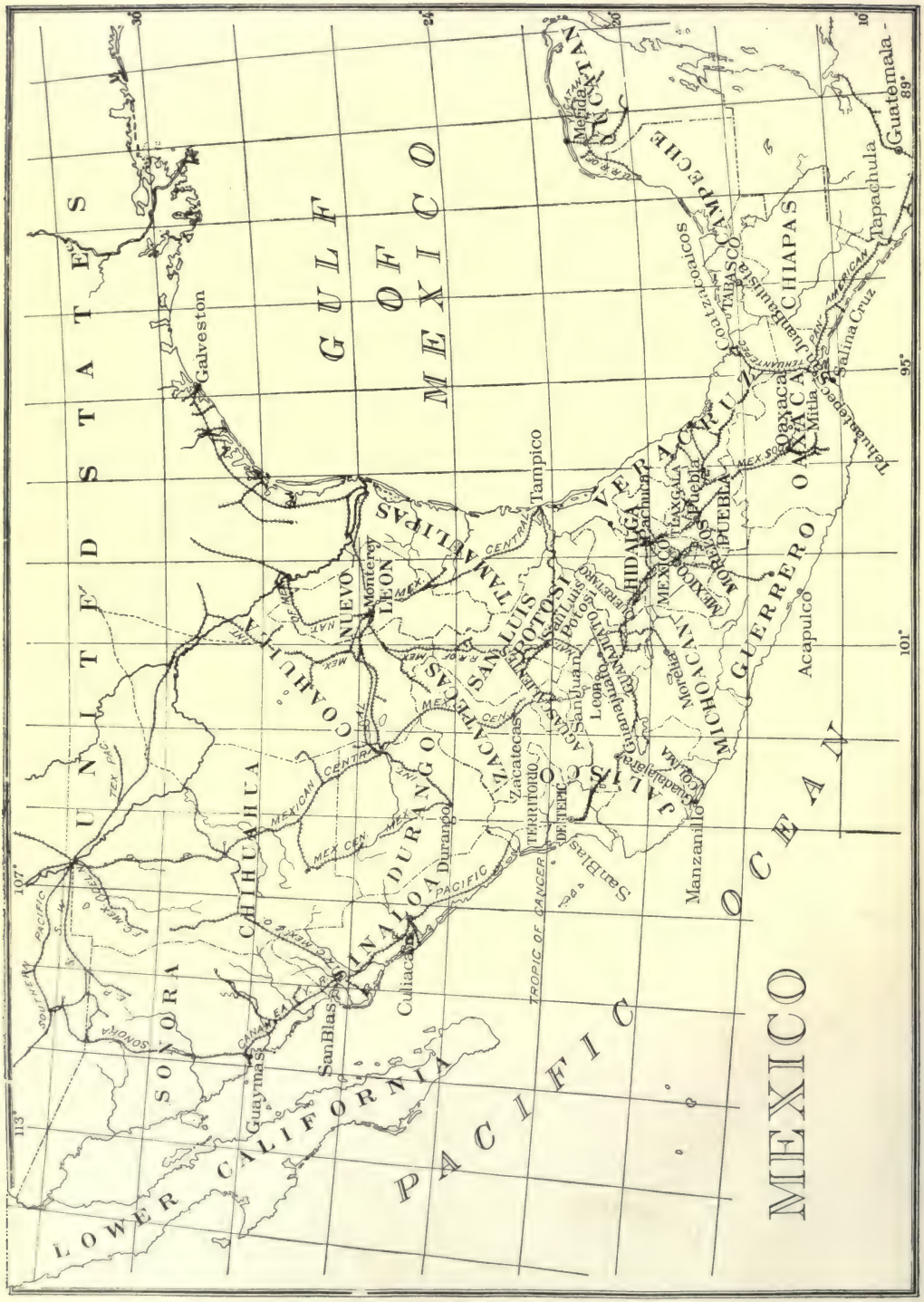
A PROLIFIC COFFEE TREE: MEXICO

VIEW OF A DEEP BARRANCA IN MEXICO Photo from Mrs Harriet Chalmers Adams

This picture shows the interception of these wonderful gorges in the midst of comparatively level plains

SCENE ON THE PACIFIC COAST: SINALOA, MEXICO

Photo from Chas. Kirby Fox



OUTLINE MAP OF MEXICO

A NORTH HOLLAND CHEESE MARKET

By Hugh M. Smith

Deputy Commissioner, U. S. Bureau of Fisheries

ALKMAAR, celebrated in Dutch history for its successful defense against the Spaniards in 1573, has been noted in modern times for its cheese trade, which is the most extensive in North Holland. The town, of 20,000 people, displays the neatness and cleanliness typical of the country, but would have little attraction for foreign sightseers beyond its quaint seventeenth century domestic architecture were it not for the great market in round yellow cheeses with which, in America, the name Edam is associated.

The market is held every Friday, and is participated in by the dairymen of all the surrounding districts, some of whom bring their cheeses in wagons and carts, while others find it more convenient to come in canal-boats. Preparations for the market begin the day before, as considerable time is required for the unloading and arranging of the cheeses, and the afternoon before a market day is an occasion of much bustle. The intervening night interrupts operations on the market space, but bands of young peasants, men and women, parade the streets all night

THE CHEESE MARKET IN FULL SWING Photo by Hugh M. Smith

A part of the golden field as seen from a window in the weigh-house tower. Each of the piles contains from 500 to 900 cheeses

THE WEIGH-HOUSE AT ALKMAAR, 1582

In the canal are barges in which cheeses have been brought to market

long singing and skylarking, and cheese carts continue to arrive in the darkness and clatter along the stony pavements. Therefore there is little sleep for the visitor who has come to Alkmaar the day before to be ready for the great sale.

The market is held in a large rectangular, stone-paved square bounded on one side by a canal and on three sides by tall buildings occupied by shops and restaurants. The weigh-house, formed more than three centuries ago out of an already existing church edifice, dominates the market place. Its shapely clock-tower has moving figures of horsemen in a tourney and a beautiful carillon, one of whose airs is the wedding march from Lohengrin. Fancy buying cheese under such romantic circumstances!

The cheeses, whether in wagons or boats, are not carried in bulk, but are carefully arranged in layers separated by boards to prevent crushing or bruising. When ready for unloading, the wagons are drawn as near as practicable to the spaces assigned to their respective owners, and the canal-boats are moored alongside the quay; then, a piece of canvas having been spread on the stones, the cheeses are unpacked and arranged in square or oblong piles with narrow walks between. Usually the piles are 8 or 10 cheeses wide and 30 to 50 long, but some are only six cheeses square, and the piles are always two layers deep. The largest single pile at the market, here illustrated, contained 900 cheeses.

Photos by Hugh M. Smith

CHEESES BEFORE THE WEIGH-HOUSE

The unloading of the wagons and boats is one of the most interesting features of the market. One man, standing in a wagon or boat, takes two cheeses at

A REMOTE CORNER OF THE MARKET

A pair of official porters are taking a tray-load of cheeses to the weigh-house. The picture shows how carefully the piles are covered until and after the hour of the market

a time, one in each hand, and throws them to a man, either sitting or kneeling on the ground, who arranges them in regular piles. If the distance is considerable, an intermediate catcher and thrower may be required, but a throw of 30 feet presents no difficulties. The cheeses go through the air as though tied together, and are dexterously caught, a fumble being almost unknown. At times, especially during the strenuous half hour preceding the opening of the market, the yellow balls fly thickly in all directions.

Pending the beginning of the sale, the finished piles are covered with canvas, which is often supplemented with rush mats, straw, or grass, to protect the cheeses from sun and rain, and also to prevent drying of the surface; during the night, also, the canvas is thrown over the piles. We would not expect a Dutch tradesman to neglect any precaution that will improve the appearance of his goods; consequently we find that the cheeses are thoroughly greased to make them look fresh and inviting, and immediately before the sale some of the vendors, with a dish of oil and a soft cloth in hand, will liberally anoint every cheese in the upper layers.

Shortly before 10 o'clock the four large balance-scales in the weigh-house are adjusted with the most scrupulous care by a man in silk hat and frock coat, and a large number of aged porters ("Kaasdragers") congregate in an adjacent room and soon emerge clad wholly in white except for their black slippers and bright-colored straw hats. The hats are of blue, red, yellow, green, purple, and other distinctive colors, with ribbons of the same shade hanging down behind, and the men wearing the same colors work together in pairs.

Promptly as the clock in the weigh-house tower sounds the hour of 10, the bustle assumes a new aspect; promiscuous conversation, with a strong caseous bias, ceases and cheese becomes the sole topic; the countrymen remove the coverings from their product, and the whole field bursts into golden bloom, and im-

Photo from Hugh M. Smith

WINDMILL OF WALCHEREN, OF THE PROVINCE OF ZEALAND, HOLLAND

The island of Walcheren was the scene of one of the greatest disasters in British history. When the Earl of Chatham was driven out of Holland, after the invasion of the summer of 1809, he left 15,000 troops on Walcheren. More than one-half of them perished here from swamp fever before relief came in December, and half of the remainder were permanently disabled. All the photographs given on pages 1054-1066 were taken in the province of Zealand, whose inhabitants still retain many quaint and archaic peculiarities of dress, and speak the variety of Dutch known as Low Frankish.

BUSY CHILDREN OF WALCHEREN Photo from Hugh M. Smith

A FARM ON THE ISLAND OF WALCHEREN

Photo from Hugh M. Smith

The island is protected from the sea by dunes and dikes, and is very fertile

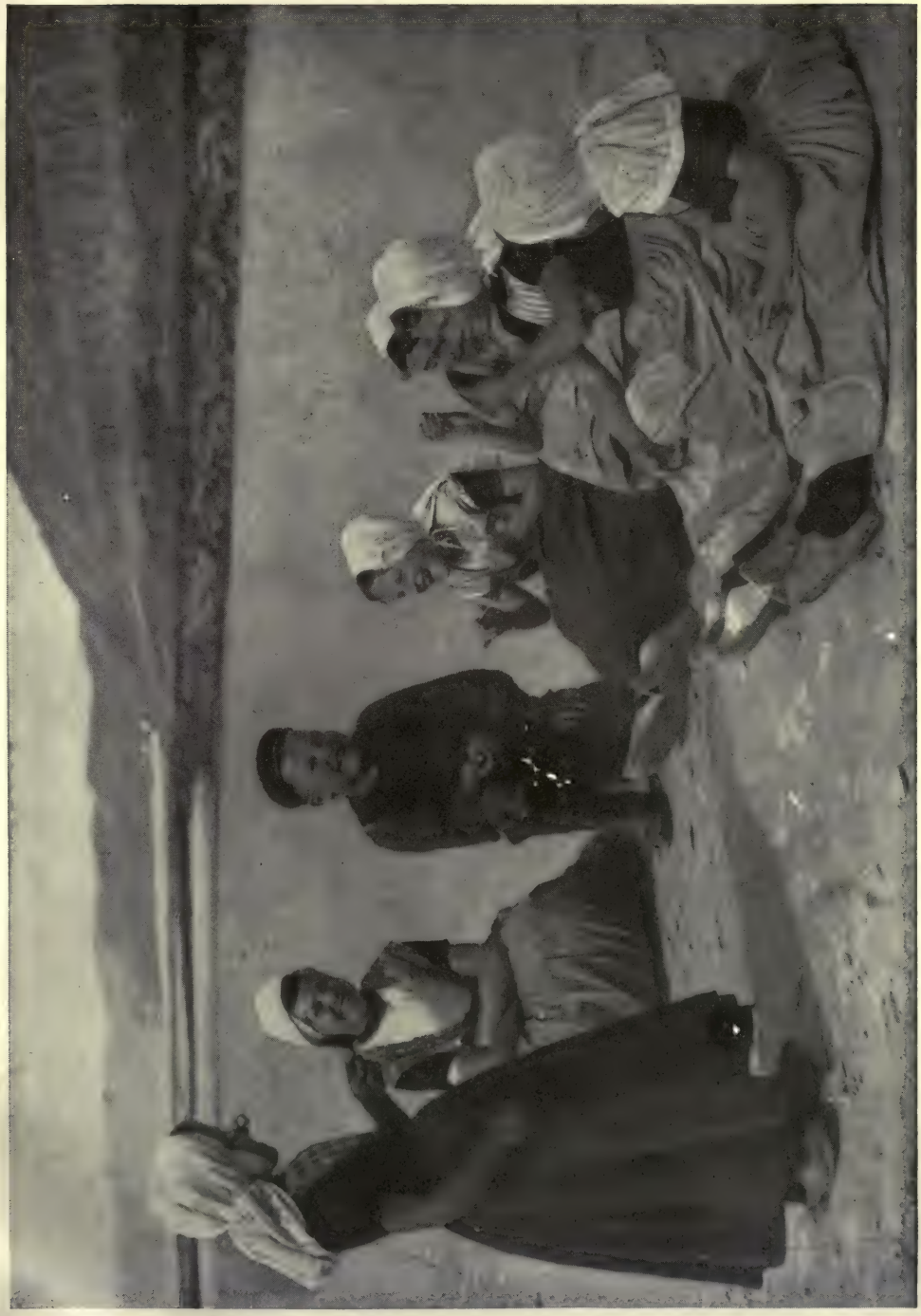


Photo from Hugh M. Smith

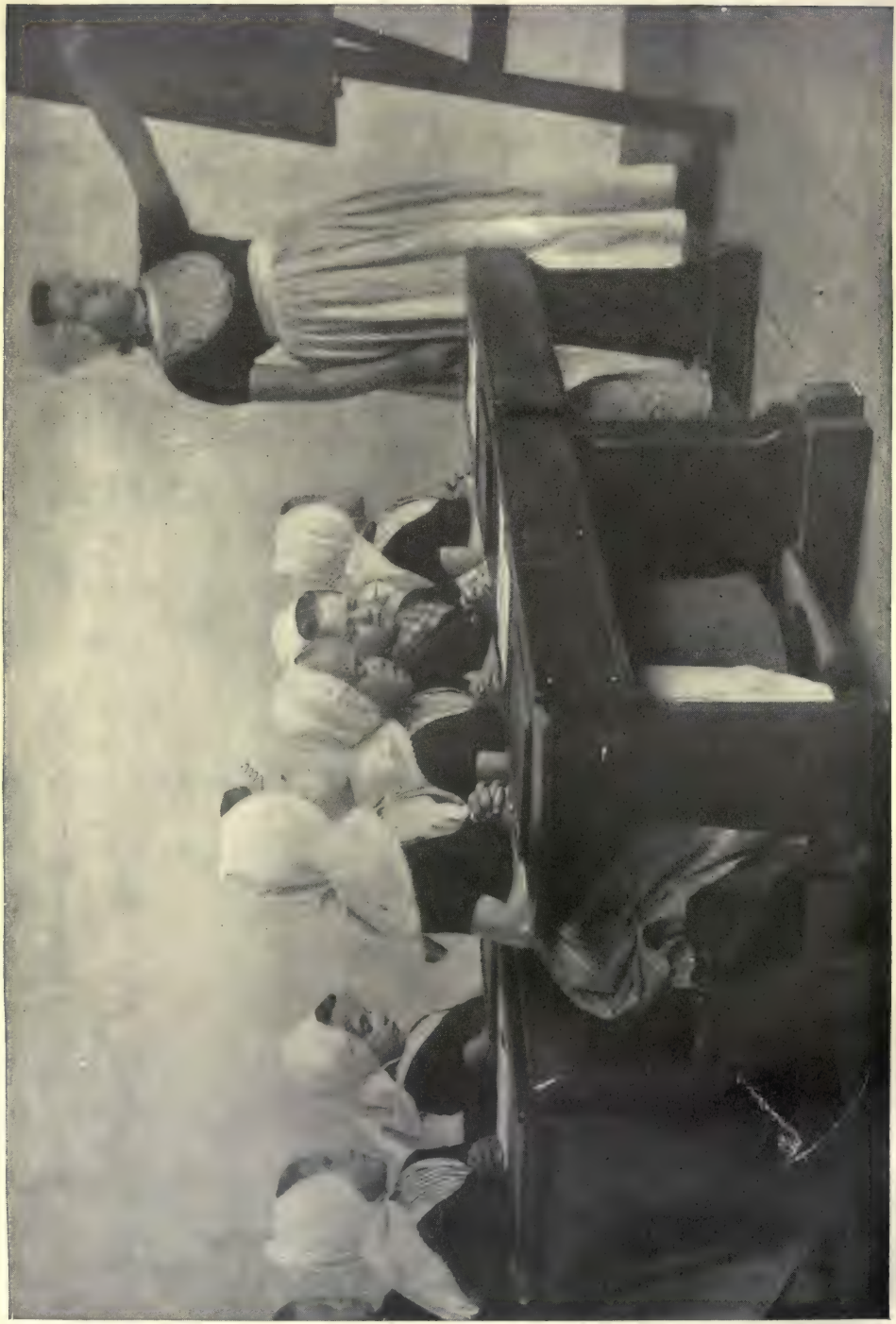
MIMICKING THE TEACHER: WALCHEREN

ON THE BEACH : WALCHEREN

Photo from Hugh M. Smith

CHILDREN PLAYING ON THE BEACH : WALCHEREN

Photo from Hugh M. Smith



A SCHOOL AT DOMBURG, WALCHEREN

Photo from Hugh M. Smith

WALCHEREN CHILDREN AND THEIR WOODEN SHOES

Photo from Hugh M. Smith

ZANTELANDE CHURCH : WALCHEREN

Photo from Hugh M. Smith

Photo from Hugh M. Smith

CHURCH INTERIOR: SOUTH BEVELAND

MARKET PLACE AT MIDDELBURG, THE CAPITAL OF WALCHEREN Photo from Hugh M. Smith

Photo from Hugh M. Smith

CHILDREN OF SOUTH BEVELAND, AN ISLAND ADJACENT TO WALCHEREN

These two islands form part of the province of Zealand, the greater portion of whose surface is below the level of the sea. The province is protected by more than 300 miles of dikes

mediately the market is in full blast. Sales are not made according to the summary "Dutch auction" fashion, but after much sparring and bargaining, during which the cheeses are felt, smelt, and tasted. Agreement upon the price for particular lots of cheese is signalized by seller and buyer striking hands, and then,

Photo from Hugh M. Smith

ANOTHER VIEW OF THREE OF THE CHILDREN SHOWN IN THE PRECEDING GROUP

the half hour having sounded, the "Kaasdragers" begin their labors, carrying to the weigh-house heaping loads of cheeses on sledlike trays suspended from their shoulders, receiving a check from the master of the scales, and returning their certified fares to the respective owners, who now have a basis for determining the aggregate weight and value of each lot as sold.

The selling and weighing proceed with such expedition that by 11 o'clock the market is practically over, and the removal of the cheeses to the warehouses of the purchasing merchants begins. Soon thereafter the country people depart in their wagons and boats, and when the carillon gives its grand noonday performance the market exists only as a memory.

On the occasion shown in the accompanying photographs nearly a hundred different manufacturers were represented, and the number of cheeses displayed on the ground and disposed of during the market hour was about 100,000.

AN IDEAL FUEL MANUFACTURED OUT OF WASTE PRODUCTS

The American Coal Briquetting Industry

By Guy Elliott Mitchell

HOW perfectly formed some of the hills of that range are, lying just to the left of the railroad. They look symmetrical enough to be artificial."

"Well, they do, for a fact. To tell you the truth, they are. They were made by men."

"Made by men? Mound-builders? Why, there are dozens of them; those abrupt slopes are hundreds, almost thousands of feet long—a regular mountain chain."

"True, and they are uniformly the most valuable mountains in existence; but they are, indeed, man-made; at the same time they are waste. They are mountains of solid carbon—coal dust—culm and slack from the mines—millions of tons of it."

More than one traveler has remarked thus on the huge coal-dust hills which break the skyline of the various coal-mining regions. Last year the coal mined in the United States was 445,000,000 tons; but in the process of mining

A HILL CONTAINING THOUSANDS OF TONS OF ANTHRACITE COAL WASTE, OR REJECTED CULM: SCRANTON, PENNSYLVANIA

Probably 200,000,000 tons of anthracite, worth $200,000,000, were lost last year as dust and waste, which, if converted into briquets, as in Germany or France, could have been profitably used. The heating value of this coal dust is even greater than that of the marketed coal. Billions of dollars have been thus wasted in the United States since coal mining began.

about 40 per cent of the deposits, or about 300,000,000 tons additional, was wasted, and a good proportion of this is represented by coal dust—culm, or slack, as it is called. Most of it is waste; it is either dumped back into the mines as "filling," or it is burned to get rid of it. The amount of such waste since coal-mining began in the United States can be stated only in billions of tons. And the heating value of this coal dust is even greater than that of the marketed coal.

BRIQUETTING AN IMPORTANT EUROPEAN INDUSTRY

In Europe no such destruction occurs. The coal dust is pressed up into briquets, which make a higher grade fuel than the run-of-mine coal. Germany manufactures 17,000,000 or 18,000,000 tons a year of briquets from coal waste—the highest grade fuel she produces. In the United States briquets could be made at the coal-dust piles, from either hard or soft coal, superior to any lump coal, and sold at the mines at a cost of about $1.25 a ton. Yet we pay for our household coal, not so good, from $5 to $8 a ton. Of course the transportation item, either in coal or briquets, is always the greatest cost factor.

But some of us will yet see the coal briquet in common use in this country. It has already gained a foothold, and, as Edward W. Parker, of the Mineral Resources Division of the Geological Survey, says, it is only a matter of time and education when the briquet will come into general use. There is, he remarks, a plethora of raw material which can be made into briquets, and in the utilization of which one of the greatest steps in the application of conservation principles can be made. In "Mineral Resources" for 1908, Mr Parker made the optimistic statement that the preliminary period of failure and discouragement in the manufacture and use of briquet fuel had apparently passed, and that the industry would soon find itself on a substantial footing. In his last report he notes a marked increase—55 per cent—in the annual production, although the industry is still in its infancy.

However, the output for 1909 was 139,661 tons, valued at $452,697. As many of these briquets were manufactured practically at the point of consumption, this value represents in large measure transportation charges. When comparisons are drawn between the extensive development of the briquetting industry in Europe and the small beginnings in this country, it must be kept in mind that in foreign countries the raw fuel is relatively high-priced. In Germany, where the briquetting industry has been most highly developed, raw coal is not only more expensive, but also of lower grade than the coal of the United States. Mr Parker gives three principal reasons for the holding back of our briquetting industry: first, our large supply of cheap fuel; second, the higher cost of our labor, and third, attempts to exploit secret processes for briquet-making, under which extraordinary claims are made, but which have not proved successful in commercial operation.

The greatest cost of the briquet lies in the binder which must be used to cement the coal dust together. The cost of manufacture should be about 40 cents a ton, but the cost of adequate binding material runs as high and higher than 75 cents for a ton of briquets produced. With asphaltum residuum of the heavier petroleums, water-gas tar pitch and ordinary coal-tar pitch, all excellent binders, available for briquet manufacture, there is no reason for secrecy with regard to the constituency of patented binders.

BRIQUETS MAKE IDEAL FUEL

Briquets make splendid fuel, but the people know little of them. The better educated the public becomes in the use of briquetted fuel the more rapidly will the industry develop, the most pronounced retarding element having been the tendency to exploit secret methods of questionable merit instead of progressing along conservative lines in paths laid out by the experience of European countries. The history of the briquet industry in Europe reveals the fact that every conceivable substance having any claim as a bond has been tried. After practical

LARGE BRIQUET PILES ON A FRENCH RAILWAY: ALSO A PILE OF EGGETTES USED FOR DOMESTIC FUEL

Locomotives which burn briquets emit less smoke, consume less fuel, and attain greater speed than when fed by run-of-mine coal of the best quality

experience, the consensus of opinion has given preference to pitch made from oil or coal-tar. This tar is a by-product obtained in the manufacture of coke in by-product ovens and in the manufacture of gas, either from the destructive distillation of coal or by carburetting water-gas with oil.

Measured in percentages, our briquet production is but an infinitesimal part of our entire fuel production; yet it constitutes the very cream, for the briquet is the fuel ideal, and, as its superiority over raw coal becomes better recognized, the demand for it will force the utilization of today's mine waste. In speaking of the commercial future of the briquet, Mr C. T. Malcolmson, a mining engineer, says in a recent issue of the "Black Diamond":

"If the conservation of natural resources is to pass from the period of agitation to one productive of practical results, the briquetting of coal is one solution of the waste. The agitation for the reduction in smoke is another factor assisting this new industry. We cannot hope to take the high-volatile coals mined in Illinois and make of them, by treatment, a fuel which will be smokeless in burning under all conditions, but there are high-grade, low-volatile coals sold in the Chicago market which, if briquetted, will make a smokeless fuel.

"As a rule these high-grade, low-volatile coals are friable, and the lump coal slacks if exposed.

"The United States government has demonstrated that briquets made from these coals withstand the action of the

SOME OF THE VARIOUS TYPES OF FOREIGN BRIQUETS

Briquets range in size from little fellows no larger than a small hen's egg, intended for domestic use, to blocks considerably larger than an ordinary building brick

weather for almost an indefinite period. Briquets do not deteriorate, either in physical quality or in heat value, in being stored for several years in the open. A briquetting plant established at the mines will allow an operator to produce coal to the maximum of his lump-coal requirement and briquet such of the fine coal as does not find a ready sale. These briquets can be stored and shipped when coal cars are idle to some common distributing point, there to be held in storage until the price warrants their sale."

REMARKABLE RESULTS FROM GOVERNMENT EXPERIMENTS

The government's experiments and investigations with reference to briquets, like other phases of its fuel inquiries, have been productive of astonishing results. Based on these tests made by the Geological Survey and now being continued by the new Bureau of Mines, briquetted coal, for use at least by railway locomotives and steamships, has a bright future. Briquets are shown to have produced greatly increased energy, and, under forced drafts, proved themselves much more nearly smokeless than run-of-mine coal of the best quality. It has, indeed, been confidently predicted that the war vessel of the future will have its smoke problem solved as effectually as has been the smoke question on the firing line since the introduction of smokeless gunpowder.

In 16 comparative test trips on the Atlantic Coast Line Railroad, made under the supervision of the Geological Survey, aggregating 1,984 miles, briquets proved superior on every count. Ton for ton, the briquets ran the cars more miles than did the coal, and ran them faster. The following figures tell the tale:

	Pounds consumed	Car miles run
Briquets	161,980	12,896
Coal	172,700	10,912

Stated another way, it required, to run each car mile, 15.8 pounds of coal, but

only 12.5 pounds of briquets. With briquets employed as fuel on all the railroads of the United States, this would mean a saving of at least 30,000,000 tons of coal annually. The most impressive showing for the briquets, however, lay in the fact that it was possible to secure from them a much hotter fire and consequently greater speed than with coal, and, in these particular practical tests, to make up much lost time. This showing of increased speed is significant in these days when entire railroad routes are being retracked to cut out curves and shorten distances in order to establish faster schedules.

Further U. S. Geological Survey tests, made on Chesapeake and Ohio Railroad engines, showed that the briquet ignited more freely than coal, and therefore got up steam quicker. It made an abnormally hot fire, and, with the engine running at high speed, emitted practically no smoke. A heavy fire could be maintained without danger of clinkering, few ashes resulted in the fire-box, and the cinder deposit was very small, thus indicating almost complete combustion. Incidentally, this would suggest that if railroads burned briquets, fewer if any live coals and cinders would be belched from the engine's smokestacks to start forest fires and cause the destruction of thousands of acres of timber lands every year.

IN EVERY RESPECT SUPERIOR TO COAL

In still further government tests, made in coöperation with the Missouri Pacific, the Michigan Central, the Rock Island, the Burlington, and the Chicago & Eastern Illinois railroads—aggregating 100 locomotive tests—briquets, in almost every instance, showed greater efficiency than natural coal. Certain Oklahoma coal, for instance, gave a boiler efficiency of 59 per cent, but briquets made from the same coal gave an efficiency of from 65 to 67 per cent. Decreased smoke density, the elimination of clinkers, and the apparent decrease in quantity of cinders and sparks are cited as the chief reasons for this higher efficiency—factors which should be interesting to the public as well as to the railroad companies' exchequers.

Other interesting tests were carried on by the Survey with a locomotive mounted at the testing plant of the Pennsylvania Railway Company at Altoona, Pennsylvania, resulting in the same story—favorable to the briquet. In the report on these experiments the following conclusions have been published by the government:

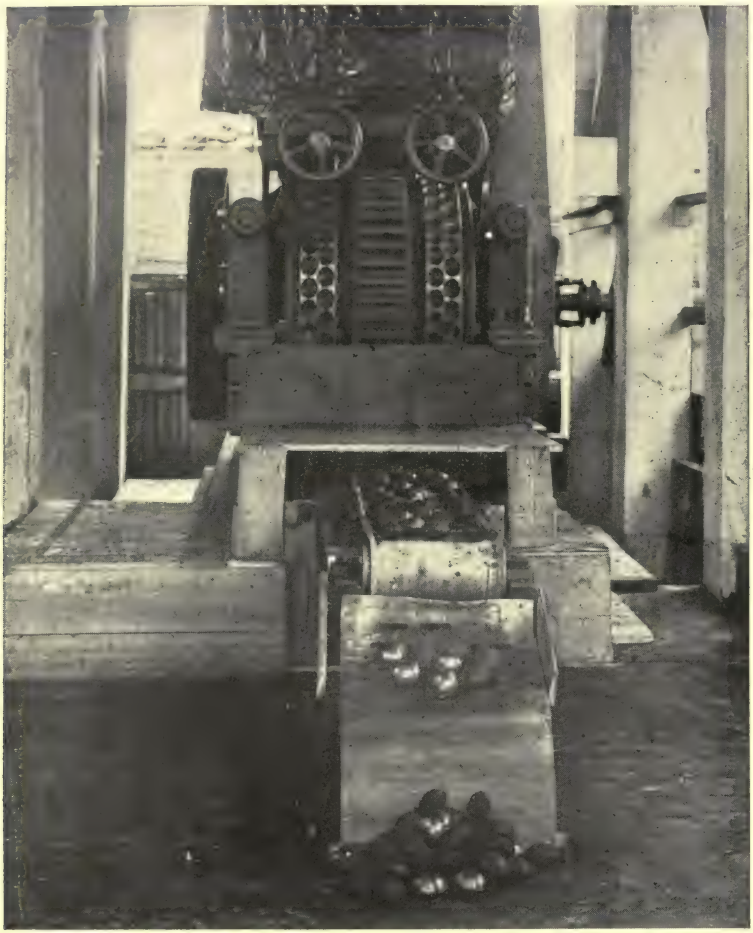
"The briquets made on the government machines have well withstood exposure to the weather and have suffered but little deterioration from handling. In all classes of service involved by the experiments the use of briquets in the place of natural coal appears to have increased the evaporative efficiency of the boilers tested. The use of briquets increases the facility with which an even fire over the whole area of the grate may be maintained. In locomotive service the substitution of briquets for coal has resulted in a marked increase in efficiency, in an increase in boiler capacity, and in a decrease in the production of smoke."

It is especially noted that the briquet, on account of its lack of smoke, may be used to advantage in running in and out of cities. In certain of the tests, for instance, the figures show an average density of smoke for coal stated at 1.7, as against but .62 for briquets.

Similar tests were carried out on the torpedo boat destroyer *Biddle,* with a very great increase in boiler capacity resulting from the use of briquets, which made a much hotter fire than had ever been possible with coal. Never before had the *Biddle* run so fast as during these briquet tests.

BRIQUETS EXTENSIVELY USED ABROAD

In a personal investigation of the briquet industry in European countries, Dr. J. A. Holmes, the present Director of the Bureau of Mines, found this form of fuel in high favor. In Belgium he found that the state railroads used briquets exclusively for passenger service. In Germany the briquet constitutes a



A BRIQUET MACHINE IN THE BUREAU OF MINES PLANT

At this station coal dust is made into briquets by enormous pressure, without the use of any binding material

fuel which, it is stated, can be handled and stored with greater facility and less loss than natural coal; as a steam producer it is most satisfactory and its use conserves the country's resources. In France Doctor Holmes found the briquet being widely used and purchased by the government railroads under definite specifications. The absence of smoke and cinders in traveling on these briquet-using trains was noticeably agreeable.

The Red Star Line steamships, according to a statement in the "Black Diamond," use bituminous briquets from Antwerp to New York, but on the return trip have to burn American soft coal. The opportunity presented for practical comparative tests is an ideal one. From reports on both classes of fuel, better time and at lower cost is made when running on briquets; it is estimated that "nearly one-third of the average coal bill is saved."

OUTLOOK GOOD FOR AMERICAN BRIQUET-MAKING

The conditions in the United States would seem to favor the gradual and

steady advance in briquet-making. The supply of the raw material—coal screenings—is a great and constant one, and the possible supply of binding material is good. Our annual coke production is now about 35,000,000 tons, and an important by-product of coke manufacture is coal-tar, an ideal briquet binder. Until recently most of our coke was made in "beehive" ovens, by which process the by-products are entirely wasted. Great by-product coke ore retorts are now rapidly displacing the wasteful beehives, a recent notable installation being at the United States Steel Corporation's huge plant at Gary, Indiana, and thus large quantities of cheap binding material are becoming available. Moreover, the binder manufacturers and the briquetting industry are showing signs of "getting together." Briquetting Engineer Malcolmson stated recently, in discussing the importance of binding material for briquet manufacture:

"There is no doubt that the successful briquetting of coal depends as much on the specifications and uniformity of the binder furnished as it does on the mechanical operations of the machinery. The consumption of pitch for briquetting purposes so far, in this country, has been so irregular and uncertain that pitch manufacturers have not been disposed to give the distillation of tar the proper consideration. In working out the problems which are always inherent in new propositions, it has been discovered that the ability to put on the market a uniform fuel necessitated a uniform quality of binder. One of the most promising indications of future success in establishing this important industry in the United States is the attitude which has recently been assumed by the leading pitch manufacturers in recognizing the necessity of a distinct product to be known as "briquetting pitch." These manufacturers also recognize the necessity of assisting in every way to establish the briquetting industry by not only spending considerable money in developing a pitch of the requisite specifications, but also placing that pitch on the market at a price which will make the briquetting of coal commercially possible.

A NUMBER OF BRIQUET PLANTS IN PRACTICAL OPERATION

In Mineral Resources for last year, Mr. Parker, of the United States Geological Survey, describes the briquetting plants in active operation. The plants are located in New York, Pennsylvania, Massachusetts, Rhode Island, Indiana, Illinois, Michigan, Iowa, Missouri, Oklahoma, Montana, Washington, Oregon, Texas, and Wisconsin.

The briquets range in size from little fellows no larger than a small hen's egg, intended for domestic use, to blocks considerably larger than an ordinary building brick. They are variously termed "boulets," "eggettes," "carbonets," "patent fuel," "coalettes," and "briquets." The briquet machines have capacities ranging from a few tons to 40 or more tons per hour. The coal or slack is finely crushed and then mixed with the pitch or binder like a pudding, superheated and saturated steam and water being used to obtain a conglomerate of the right consistency, varying with different coals. The material is then forced into the molds and subjected to a heavy pressure of a ton or more to the square inch. Thereupon issues the completed briquet.

HUGE LIGNITE BRIQUETTING MACHINE

A statement of the possibilities of the briquet industry in the United States would not be complete without reference to the promising lignite briquetting experiments being carried on by the Bureau of Mines. At the Pittsburg station of this bureau there has been installed a huge German briquet machine, in which briquets are made by enormous pressure, without the use of binders. The machine develops a pressure capacity of from 14,000 to 28,000 pounds per square inch, and is typical of the plants used in Germany with great success for briquetting brown coal. Tests have already been made with Texas, North Dakota, and California lignites in order to determine

whether the vast stores of American lignites cannot be briquetted without the use of artificial binders, under the same conditions as prevail in Germany for briquetting brown coal, which is analogous to our lignite. The results from these preliminary tests have been in the main highly satisfactory.

The tests proved that not only can lignite be briquetted, but that the reduction of the moisture incident to the briquetting process increases the heat value of the briquets obtained by from 37 per cent to 54 per cent over that of the raw fuel. This improvement in heat value will be of great importance to a consumer, as a greater efficiency is obtained from the combustion of fuels of high-heat value than from those of lower-heat value. The experiments have also conclusively demonstrated that the briquetted fuel withstands the effect of weathering several months longer than the raw fuel, thus making possible the transportation of the lignite briquets, which is not practicable in the raw fuel, owing to its tendency to crumble and slack.

As a whole, the coal-briquetting industry in the United States gives promise of a fine development in the near future; it should give us a fuel of the greatest value and convenience for both industrial and domestic uses, and there is satisfaction in the knowledge that whatever the growth of the briquet production it means in effect the creation of something out of nothing, since the materials which constitute this fuel are at present a dead waste.

NATIONAL GEOGRAPHIC SOCIETY

THE series of illustrations in color published in the November number of this Magazine has proved so popular that a similar series will be published at least twice in 1911. The next number will contain the address recently delivered before the Society by ex-President Roosevelt, illustrated by many photographs by Mr Kermit Roosevelt. The same number will also contain an unusual series of photographs, showing the immense work being done on the Panama Canal.

The annual dinner of the Society will be held Saturday evening, January 14, at the New Willard. The dinner is in honor of the U. S. Army and of the art of aviation. The principal guests of honor will be Messrs Wilbur and Orville Wright. There will be addresses by President Taft, the German Ambassador, the Mexican Ambassador, Major General Leonard Wood, Chief of Staff U. S. Army, and Mr Wilbur Wright. Members desiring to attend should send their applications at once. Price per plate, $5.00.

January 6.—"Arab Life in Tunisia." By Frank Edward Johnson.

January 13.—Annual Meeting, Hubbard Memorial Hall, 5 p. m.

January 13.—"The Methods, the Achievements, and the Character of the Japanese." By Mr George Kennan. Illustrated.

January 20.—"Making Pictures. The Wonderful Development of the Art of Photography and Its Value to Education and Commerce." By Hon. O. P. Austin, Chief of the United States Bureau of Statistics and Secretary of the National Geographic Society. Illustrated with motion pictures.

January 27.—"The Panama Canal." By Col. George W. Goethals, Chief Engineer Panama Canal. Illustrated.

February 3.—"Our Plant Immigrants." By Mr David Fairchild, in charge of Agricultural Explorations of the Department of Agriculture.

February 10.—"The Balkan States." By Mr E. M. Newman. With motion pictures.

February 17.—"The Heart of Turkestan." By Mr William E. Curtis. Illustrated.

February 24.—"The Italy of Today." By Maj. Gen. A. W. Greely, U. S. Army.

March 3.—"The Birds of Mexico." By Mr Frank M. Chapman, of the American Museum of Natural History.

March 10.—"From the Amazon to the Orinoco. The Five Guianas." By Mrs Harriet Chalmers Adams. With motion pictures.

March 17.—"Travels and Experiences in Mexico." By Mr John Birkinbine, President of the American Institute of Mining Engineers. Illustrated.

March 24.—"The Shrines of Greece: Olympia, Delphi, Eleusis, Athens, Mycenæ, Tiryns, Epidauros, and the Island of Crete." By Miss Marion Cock. Illustrated.

March 31.—"The Romance and Grandeur of Spain." By Dr Charles Upson Clark, of Yale University. Illustrated.

April 7.—It is hoped that former Vice-President Charles W. Fairbanks will be able to address the Society on this date on some subject connected with his recent journey around the world.

April 14.—"The Fiords and Fisheries of Norway." By Dr Hugh M. Smith, Deputy Commissioner of the Bureau of Fisheries. With motion pictures.

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